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THE PLANT DISEASE REPORTER

Issued By

PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops Research Branch — Plant Industry Station, Beltsville, Maryland

Volume 39 — August 15, 1955 — Number 8

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NEMATODE DISEASES OF STRAWBERRIES IN THE NETHERLANDS[1]

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Black-root Rot

The most important nematode disease of strawberries in The Netherlands is the black-root rot. Black-root rot occurs in several districts, especially on strawberries on the sandy soils. In the district of Kennemerland, the country just behind the dunes, it greatly reduces the strawberry crops. Black-root rot is rather serious also in the district near Breda, in the South. Work on this disease was done mostly in Kennemerland and at our Institute at Wageningen with plants or soil coming from Kennemerland. Here the plants grow on dune sand, blown in from the sea by the west winds and leached by the rains. The fields have been leveled, the dune sand being used for the building of our towns. The flat lands remaining are used in small parcels, with high hedges (mostly alder) between them; otherwise the soil would be blown away by the strong winds. The water table in the soil has become very low and because the dunes are excellent filters the water is used for the towns. During some years the water from the deeper layers is pumped up and used by many growers for irrigation of the fields. The pH is about 5.5 to 6.5. The main crops are strawberries, vegetables (carrots, peas, lettuce, and others), tulips, narcissus, irises, gladiolus, and lilies.

The work on black-root rot of strawberries started in war-time. The disease had already been known for years in the district. During the first years, the reports and descriptions of the local people were vague and contradictary, but after a while we found that we were mixing black-root rot and Verticillium wilt. This latter disease occurs also elsewhere in our country, but it is generally not very serious in strawberries; its seriousness depends on the weather. We could see microscopically that the roots of the strawberry plants were infected with fungi and rather regularly we also found nematodes, especially in lightly attacked roots.

I isolated many, many fungi. With these I tried to infect sterile seedlings of Fragaria vesca alpina, which are easy to handle and are susceptible to black-root rot. Some of the fungi proved virulent to test-tube-grown sterile seedlings, but the same fungi did not infect strawberry plants grown in pots in sterilized soil or in unsterilized garden soil. The nearly always present mycorrhiza did not seem primarily dangerous either.

We found nematodes again and again in slightly affected roots and less regularly in roots which were severely diseased. When we failed again and again to infect plants with isolated fungi, we began to consider the nematodes as the possible cause of the disease. This seemed very probable, but we had no proof. To prove the causal relation of nematodes to a disease is very difficult, because you need nematodes without fungi and fungi without nematodes. We could only with difficulty isolate nematodes from our soils, because they contain many 50- to 100-micron particles; their sedimentation rate is near that of the nematodes. A special method for isolating nematodes from that type of soils has been recently worked out by Dr. J. W. Seinhorst at our Institute. To put only nematodes into sterilized soil, you must surface-sterilize them. I doubt the possibility of this with Pratylenchus, especially if you have only a few to work with.

I tried to obtain fungi without Pratylenchus. If you take a mixture of isolated fungi, you still have only a selection of the real population of fungi in the soil. I mixed, therefore, sterilized black-root-rot soil with a very good compost from a garden where strawberries grow very well. In this compost we can expect a vigorous population of soil organisms (soil inhabitants, according to Dr. S. D. Garrett) which do not infect strawberry roots. This was proved by mixing sterilized black-root-rot soil with this compost. You see the results in Table 1. If you put nematodes into this mixture (IV), then the roots become severely attacked with black-root rot. Even this is not final proof, because the nematodes are not sterilized. It is, however, very improbable that from the few fungus spores which are carried into the soil with the

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[1] Paper presented at the Strawberry Conference, Beltsville, Maryland, May 27, 1955.

[2] Formerly plant pathologist for strawberry diseases of the Institute for Phytopathological Research (IPO) at Wageningen, The Netherlands (1943 to 1954). Since February 1954 the writer has specialized in the nematological department of the same Institute on root nematodes of crop plants.

Table 1. Growth of Alpine strawberry seedlings in "root-rot" (r.r.) soil, in steamed root-rot soil to which nematodes were added, and in various mixtures of root-rot soil and compost.

Mixture	Growth	Root development and condition
I -- r.r. soil	Bad	Few, rotted
II -- steamed r.r. soil + nematodes + roots	Bad	More than in I, rotted
III -- 3/4 r.r. soil + 1/4 compost	Rather bad	Many, rotted
IV -- 3/4 steamed r.r. soil + 1/4 compost + nematodes	Rather good	Many, rotted
V -- 3/4 steamed r.r. soil + 1/4 compost	Good	Many, healthy

nematodes many of these weak parasites would develop, because there is already a vigorous population of saprophytic soil fungi. According to Garrett, these are antagonistic to the parasites and it would be very difficult for the latter, even if present, to develop so vigorously that they would cause serious root rot.

Mixture II was used to learn whether when you separate the three components of the soil (soil, nematodes, fungi) and mix them together afterwards, a severe attack of black-root-rot followed. "Roots" refers to the chopped strawberry roots which we put into the soil to re-introduce the fungus-complex. Mixture III was used to show what happens when root-rot soil is mixed with the compost.

We found Pratylenchus penetrans in strawberries. We have no proof that the other Pratylenchus species (pratensis, minyus, and thornei) which have been found in The Netherlands can, under our conditions, attack strawberry plants.

The growers could not wait until we had finished and evaluated the laboratory tests. Therefore, we tried a field experiment in Kennermerland in 1946, just after the War. In these years, many discussions about the influence of organic matter on soil structure were held. Therefore, we compared plots with four replications given the following treatments:

(a) A soil disinfectant; we used formalin, not because we considered it the best disinfectant but because it was the only one we could obtain.
(b) A dressing of compost.
(c) None (control).

As I stated previously, the soil is dune sand. It is the custom to use considerable stable manure before planting strawberries on this soil. All our plots got the normal dressing of stable manure and on top of this, compost was applied to plots b. It was a small experiment, under difficult conditions. The formalin-treated plots, and lastly the controls.

After this, a second experiment was started. We then had the idea that possibly nematodes were the cause of the disease. We wanted to use a nematocide which was not fungicidal and a fungicide which does not kill nematodes. This cannot perhaps be done. The Royal Dutch Shell people helped us with DD (in a concentration which -- according to them -- is not fungicidal) and they gave us a very secret fungicide (I still do not know what it was). The DD plots were much better than the others.

In the meantime, the horticultural advisor from the district also tried out several nematocides and formalin. Chloropicrin and DD gave the best results in the beginning; later DD was the best. Formalin and ethylene dibromide were less effective. Formalin is effective for only a short time. The first crop is much better, but later on the effect of formalin diminishes rapidly. The advisor suggested to the growers that they use formalin, even if it is not quite satisfactory, because chloropicrin, though not phytotoxic, was too expensive and it is rather difficult to apply the water seal. Sometimes there is no water because some fields are not irri-

gated. DD is also expensive and very phytotoxic. It must be used in September, when the soil temperature is still high enough. The growers then lose a late crop. They cannot apply DD themselves; it is sold only to professional sprayers. Formalin can be used during the winter, when the last crop is harvested. It is rather cheap and easy to apply. The growers can apply it themselves. (The growers in the Heemskerk district are small farmers, often relying entirely on their strawberry crop; they cannot spend much on pest control.) So we need an inexpensive soil nematocide, easy to handle and usable at low temperatures.

Last year a new field experiment was planned, but this time entirely from the nematological point of view. Dr. Seinhorst's method of isolating nematodes from the soil proved satisfactory and we had some routine experience in working with his apparatus. In a Latin Square we compared the following with the controls: Two concentrations of DD (65 cc/m^2 and 32.5 cc/m^2) and two concentrations of formalin (300 cc/m^2 and 150 cc/m^2). Thus both chemicals were used at the usual concentration and at half-concentration. Every plot (of 5 x 5 meters) was subdivided into 9 equal parts and from every part we took a soil sample, with 20 pricks of the soil auger.

The first samples were taken in August 1954. In September the DD was put into the soil. In October and December we sampled again. The formalin treatment was carried out later in December, during very suitable, mild winter weather, characteristic of early winter in our country. Afterwards the soil was frozen for nearly three months. Late in March the whole field was sampled again. In April the strawberries were planted according to the custom in that district, with a second crop between the rows, in this case carrots.

The statisticians worked over our data. The results as far as known before I left were as follows: (a) The DD worked so well that mathematical treatment was superfluous. A few nematodes were still left after the soil disinfection. During the winter their number still decreased. (b) The formalin did nothing at all to the nematodes. There was no significant decrease, considering also that during the winter the number of nematodes in the controls were also more or less reduced. (c) The method of soil sampling was satisfactory.

How to proceed is still a question. If you take soil samples when the strawberries are in the field, you get wrong numbers of nematodes because many nematodes are in the roots. If you regularly take plants with their root systems out of the plots, you spoil the experiment. If you sample severely diseased spots, you will probably find fewer nematodes than in soil beneath the healthy plants, because the nematodes reproduce less than in spots where there are still healthy roots to attack. Our idea is to sample after the carrot crop is harvested. By then the first strawberry runners have not yet rooted. (The runners are left to produce matted rows). The following year, the crop will be carefully weighed and we shall note on the maps where severe black-root rot appears (as far as we can determine by the appearance of the tops). If something unexpected, or very interesting, happens we shall sample the plot, wholly or partly. At the end of the experiment (after 3 or 4 years) we should sample the whole field again.

To get an idea of the influence of crop rotation, we take soil samples twice a year from fields in several parts of the country. We include as many fields in the root-rot surveys as possible.

Some of our strawberry fields are not yet infested with Pratylenchus penetrans and it is still possible to grow runners with healthy roots. But we will take your findings as a warning and we will do our utmost to investigate the soils of our propagation fields to keep our certified plants healthy and to avoid being obliged to use the hot-water treatment. It will be better to use DD instead of formalin, even if it is more expensive and more difficult for the growers.

Bud and Foliar Nematodes

In The Netherlands, strawberries are attacked by two species of bud and foliar nematodes, Aphelenchoides fragariae and A. ritzema-bosi. Both also attack other plants, especially flowering plants (chrysanthemum, begonia, and violets) and ferns. They can live on many weeds, probably on more species than we know, because often weeds no not show symptoms.

We are not sure that nematodes from all these plants can infect strawberries. It is possible that there are several strains; about this, little is known. The symptoms vary according to the strawberry varieties. Seldom do we find "cauliflower-plants." According to Dr. R. S. Pitcher of England, these symptoms are caused by a rare, virulent strain of a bacterium disseminated by the nematodes.

Most of our common strawberry varieties are moderately susceptible to nematodes. Mme. Lefeber and Mme. Moutot are very susceptible, especially the latter which is much liked by the growers. We have much trouble with Mme. Moutot.

Still, in The Netherlands the foliar nematodes can be kept in check by roguing. The rather difficult hot-water treatment is not necessary in our country, except perhaps to save valuable clones. In the district where much Mme. Moutot is grown and where many fields were severely infected, it is now, after about 8 years' attention to this nematode disease and constant roguing, difficult to obtain plants with symptoms. The propagation fields are kept well isolated and the inspections before certification are very thorough; these two control measures proved satisfactory.

Stem Nematodes

Several strains of Ditylenchus dipsaci can infect strawberries; for instance those of red clover, rye, and narcissus, and probably also the onion, potato, and beet strains. Still, infection by stem nematodes is not serious in The Netherlands. In most cases symptoms so closely resemble those caused by the foliar nematodes that it is difficult to tell them apart. Also, the symptoms differ according to the strain of the nematode and the strawberry variety.

Sometimes plants are simultaneously infected with both foliar and stem nematodes. The only means of control are roguing and not growing strawberries in fields known to be infested with stem nematodes. Hot-water treatment has not been necessary.

INSTITUUT VOOR PLANTENZIEKTENKUNDIG ONDERZOEK, WAGENINGEN, NETHERLANDS

A COMPARISON OF TWO METHODS OF ROW FUMIGATION FOR CONTROL OF ROOT KNOT OF CANTALOUPE IN SOUTH CAROLINA[1]

Robert Aycock[2]

SUMMARY

The application of Dowfume W-85, Dowfume W-40, and DD applied as a single stream in the furrow followed by immediate ridging significantly reduced galling caused by Meloidogyne incognita var. acrita and significantly increased yields of marketable cantaloupe fruit. Two streams of these fumigants applied in furrows 12 inches apart significantly reduced galling but resulted in no increase in yield over that obtained where the 1-stream method of application was employed.

INTRODUCTION

Root knot nematodes, Meloidogyne incognita var. acrita, are frequently a limiting factor in cantaloupe production on the lighter soils in South Carolina. The uncertainty of market conditions and the low per-acre returns often realized from this crop render impractical from an economic standpoint the over-all application of soil fumigants. Since data on row fumigation are lacking for this crop, experiments were performed in 1954 in which the application of a single stream of fumigant per row was compared with 2 streams spaced 12 inches apart.

PROCEDURE

Plots were laid out in two locations on Norfolk sand which previously had been planted to cotton for several years. One location was considered average for cantaloupe production in South Carolina while the other was inferior and of lower fertility. Ethylene dibromide (Dowfume W-40[3] and Dowfume W-85[3]), dichloropropene-dichloropropane (D-D[4]) and 1-3 dichloro, 2 bromo propane (Nemagon[4]) were the fumigants used. The soil, which had been disked during the winter, was turned with moldboard plows 10 days prior to fumigation, then disked again and smoothed with a drag-tooth harrow.

Rows were laid off at 6-foot intervals and fertilizer (3-9-9) was applied at the rate of 800 pounds per acre in the furrow. Each treatment was replicated 4 times, using 4-row plots, 50 feet in length. Each plot was further subdivided into subplots of 2 rows each. Plot arrangement conformed to that of the split-plot design[5].

Fumigants were applied with gravity flow apparatus[6] in subplots either as a single stream in the center of the row or as two streams spaced 12 inches apart, each plot being split for the two methods of fumigation. Prior to application, the original furrows were reopened with a shovel plow. Where the double stream of nematocide was used it was necessary to open 2 furrows per row, in order that the material would be placed 6-8 inches below ground level. Control plots were set up in the same manner except that no fumigants were applied. All furrows were ridged upon immediately after application so that the materials were about 10 inches below the top of the bed.

Rates of application of each material per linear foot were as follows: DD and Dowfume W-40, 3.6 cc; Dowfume W-85 and Nemagon, 1.2 cc. Soil moisture at time of application was about field capacity and soil temperature was 58° F. Minimum air temperatures were above 50° F on 8 of the days during the period between fumigation and planting.

Seed of Hales Best, Jumbo strain, were planted 3 weeks after fumigation in hills 3 feet

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[1] Published with the approval of the Director as Technical Contribution No. 233 of the South Carolina Agricultural Experiment Station.

[2] Formerly Plant Pathologist, Edisto Experiment Station, Blackville, South Carolina. Present address Vegetable Research Laboratory, Castle Hayne, North Carolina.

[3] Products of the Dow Chemical Company, Midland, Michigan.

[4] Products of Shell Chemical Corporation, New York, New York.

[5] Snedecor, G. W., Statistical Methods. The Collegiate Press, Inc., Ames, Iowa, 1946.

[6] Furnished by Insect Control Sales and Service, Candor, North Carolina.

Table 1. The influence of row treatments with soil fumigants on stand of cantaloupe plants.

Fumigant	Mean stand[a]		
	One-furrow Application	Two-furrow Application	Mean
Dowfume W-85	167	161	164
Dowfume W-40	165	147	156
DD	154	156	155
Nemagon	75	27	51
Control	160	168	164
Mean	144	131	—
LSD (.05)	14	14	14
LSD (.01)	20	20	20

For method of application means: LSD (.05) = 9; LSD (.01) = 13. For method of application means of the same fumigant: LSD (.05) = 20; LSD (.01) = 28.

a Stand count made 10 days after planting and based on 204 seed planted.

Table 2. The influence of row treatments with soil fumigants on yield of marketable cantaloupe fruit.

Fumigant	Yield in number of marketable fruit		
	One-furrow Application	Two-furrow Application	Mean
Dowfume W-85	84.7	73.7	79.2
Dowfume W-40	82.5	82.2	82.3
DD	86.7	73.0	79.9
Nemagon	55.0	16.7	35.9
Control	51.7	27.2	39.5
Mean	72.2	54.6	—
LSD (.05)	18.8	18.8	12.3
LSD (.01)	26.3	26.3	17.3

For differences between means for methods of application: LSD (.05) = 6.2; LSD (.01) = 8.5.

For differences between methods of application for each fumigant: LSD (.05) = 13.7; LSD (.01) = 19.0.

Conversion factor for obtaining per acre yields: 72.6.

Table 3. The influence of row treatment with soil fumigants on severity of root knot.

Fumigant	Root knot indices[a] after harvest		
	One-furrow Application	Two-furrow Application	Mean
Dowfume W-85	53.9	37.1	45.5
Dowfume W-40	29.6	17.0	23.3
DD	62.7	42.5	52.6
Nemagon	18.5	19.5	18.9
Control	81.5	81.2	81.4
Mean	49.2	39.5	—
LSD (.05)	14.3	14.3	14.0
LSD (.01)	20.0	20.0	19.7

For differences between method of application means: LSD (.05) = 6.5; LSD (.01) = 8.9.

For differences between method of application means for each fumigant: LSD (.05) = 14.5; LSD (.01) = 20.1.

[a] Indices were obtained by giving a numerical rating to 10 plants per plot according to the following scale: 0 = clean roots; 1 = trace infection; 2 = slight; 3 = moderate galling; 4 = severe, whole root system galled, but in sound condition; 5 = severe, whole system galled with root decay and disintegration. Class values assigned to each rating were as follows: 0 = 0; 1 = 10; 2 = 25; 3 = 50; 4 = 75; 5 = 100.

apart. Plants were thinned to one per hill before they began to produce vines.

EXPERIMENTAL RESULTS

Since the two sets of data obtained were similar except for certain minor variations, only one experiment will be discussed in detail.

Plant Growth: Stands were unaffected by fumigation with DD and Dowfume W-85 (Table 1). The number of plants emerging was significantly reduced in both experiments where 2 streams of Dowfume W-40 were used, but was unaffected where only 1 stream was applied. Extreme phytotoxicity occurred in plots treated with Nemagon. Not only was emergence drastically reduced, but many seedlings failed to survive. Injury was significantly greater where 2 streams of fumigant were applied.

Striking differences in plant vigor were noted. Plants in all fumigated plots, except those treated with Nemagon, grew off much more rapidly than did those in control plots. In control subplots, where 2 furrows were reopened after fertilizer application, plants were much more reduced in size than where only 1 furrow was reopened. A tendency toward this condition was also observed in certain fumigated plots in one experiment, but was much less pronounced.

Yields: Yields of marketable fruit are shown in Table 2. Mean yields for plots treated with Dowfume W-85, Dowfume W-40 and DD more than doubled those harvested from the control plots. Subplots which received only 1 stream of these materials appeared to outyield those which received 2 streams, but this difference was not significant except in the case of DD. The extremely low yields in Nemagon treatments were caused by phytotoxicity which occurred in the seedling stage. Where the single stream of fumigant was applied, Dowfume W-85, Dowfume W-40, and DD outyielded the appropriate control by approximately 60 percent. Control subplots in which 2 furrows were reopened after fertilizer application yielded only about 1/2 that of subplots in which only 1 furrow was reopened.

Root Knot Indices: After harvest was completed roots of 10 plants from each subplot were examined for severity of root knot. Results are shown in Table 3. The application of 2 streams of Dowfume W-85 and DD resulted in significantly lower mean root knot indices than did those where only 1 stream was applied. Dowfume W-40 gave significantly better control than did Dowfume W-85 and DD, regardless of how applied. Best control was obtained in plots treated with Nemagon.

DISCUSSION

These results show that either Dowfume W-85, Dowfume W-40, or DD applied as a single stream in the row is effective in recovering yields lost by heavy root knot infestations. Applying 2 streams per row at the same rate per linear foot further reduced the amount of galling, but resulted in no increase in yield over the 1-stream method of application. Since root knot was equally severe in both control subplots, the lower yields obtained where 2 furrows were reopened indicates that some factor other than nematode infestation was involved. This tendency was partially overcome in fumigated plots. Hence, it appears that the opening of 2 furrows might have resulted in an unfavorable placement of the fertilizer and that plants in treated plots might have had an advantage over control plants in obtaining nutrient elements because of their healthier root systems. Where partial control was obtained root systems were more extensive and plants were not so affected by fertilizer placement.

Reduction in the amount of galling where a double stream of fumigant was applied indicates that a larger zone of protection was afforded and probably also that many infections were delayed.

EDISTO EXPERIMENT STATION, BRANCH OF CLEMSON COLLEGE, BLACKVILLE, SOUTH CAROLINA

CONTROL OF BACTERIAL SPOT IN TOMATO FIELDS WITH STREPTOMYCIN-TERRAMYCIN SPRAYS[1]

Robert A. Conover

SUMMARY

Results of two experiments with streptomycin-Terramycin for control of bacterial spot in tomato fields are reported. In one, use of sprays containing 200-20 ppm. of the antibiotics resulted in 67 percent less fruit infection, 12 percent increase in fruit size, 50 percent increase in yield of bacterial-spot-free fruit, and 25 percent increase in total yield, when compared to check plots. Corresponding figures for 100-10 ppm. sprays were 28 percent, 7 percent, 22 percent, and 10 percent. In the second experiment, 200-20 ppm. sprays caused 85 percent and 72 percent reduction in fruit infection in areas set respectively with healthy and bacterial-spot-infected transplants; healthy transplants sprayed with 100-10 ppm had 74 percent less infected fruit compared to check plots. A 40 percent reduction in cracking and scarring of fruit was noted in the second experiment, but size was unaffected. Fruit infection increased markedly when fruit were picked while the vines were wet and decreased sharply when vines were dry.

INTRODUCTION

Following the report of control of bacterial spot (Xanthomonas vesicatoria (Doidge) Dowson) in tomato plantbeds with streptomycin[2], an agricultural formulation containing streptomycin and Terramycin was used during the fall of 1954 by a rather large number of Dade County farmers to protect tomatoes in plantbeds against bacterial spot. Most sprays applied contained 200 ppm. streptomycin. Control obtained from this commercial use varied from excellent to rather poor, depending on the situation and manner in which the antibiotics were used. The most common faults contributing to inferior control were delaying the use of streptomycin until the disease was present and poor spray coverage. A more detailed analysis of the commercial use of streptomycin in tomato plantbeds has been presented elsewhere[3].

Use of bacterial-spot-free transplants resulted subsequently in less damage from the disease in the field. This effect was most pronounced in isolated fields set near the end of the rainy season. However, bacterial spot caused damage to some fields set with disease-free plants several weeks prior to the end of the rainy season, especially when these fields bordered other fields in which the disease was established.

The rainy season usually ends around mid-October in South Florida. While scattered showers do occur later, these usually are not frequent or severe enough to cause bacterial spot to sweep over an area. But they are sufficient to keep the disease active on plants on which it is already established and to cause a slow spread to adjacent plants. Seeding of tomato plantbeds starts in late August in Dade County, with some transplanting to the field beginning by mid-September. Some tomatoes are seeded directly in the field during this time. Thus there is a need for field control of bacterial spot to supplement plantbed control, particularly for fields set or seeded prior to October.

Coe[4] has reported field control of bacterial spot with sprays containing 400 ppm. streptomycin. In his experiments, control measures were not started until the disease was generally established and the plants were setting fruit. Any control of bacterial spot under these conditions in weather favorable for its spread is a notable achievement.

If streptomycin is to be used economically in the field, it must be used in dosages lower than those used by Coe. At present prices, even much lower dosages could not be used economically throughout the growing season. However, study of the epidemiology of bacterial spot under South Florida conditions suggests that streptomycin might be used economically and ef-

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[1] Florida Agricultural Experiment Station Journal Series, No. 397.

[2] Conover, Robert A. 1954. Control of bacterial spot of tomato and pepper seedlings with Agrimycin. Plant Dis. Reptr. 38: 405-409.

[3] Conover, Robert A. 1954. An evaluation of streptomycin sprays for bacterial spot control in commercial tomato plantbeds. Proc. Florida State Hort. Soc. 67: 105-107.

[4] Coe, Donald M. 1955. Progress report on the use of streptomycin for the control of bacterial spot of tomatoes under field conditions on South Florida sandy soils. Plant Dis. Reptr. 39: 215-218.

fectively in the field if one were to apply it as a preventive until the end of the rainy season. This paper reports the results of two experiments in commercial tomato fields; one conducted to test this hypothesis, the other to determine the effects of weekly applications prior to picking on the development of bacterial spot.

The experiments were conducted under weather conditions usual for the time of year, which favored moderate development of bacterial spot. Each experiment compared untreated plots with plots sprayed with streptomycin-Terramycin[5] at concentrations of 200-20 ppm., and 100-10 ppm. Sprays were applied with a tractor-drawn power sprayer and the antibiotics were not mixed with other materials. Depending on plant size, from 3 to 7 nozzles per row were used. From 35 to 90 gallons of spray per acre were applied each application. In each experiment, the cooperator cared for the crop according to his usual practices. Detailed conditions and results from each experiment are presented separately.

EXPERIMENT I

This experiment was located in a 14-acre field of tomatoes (Homestead variety) which had been seeded in the row on August 28, 1954. The cooperator used a copper fungicide for disease control until October 11, after which he used maneb; parathion and DDT were applied to all plots to control insect pests. Each plot consisted of 12 rows of tomatoes, each approximately 660 feet long, an area slightly in excess of one acre. The treated plots were separated and bordered by untreated plots, but records were secured from only two of the untreated plots.

Seven streptomycin-Terramycin sprays were applied, beginning on September 20 when the plants were about 4 inches tall; other applications were made on September 27, 30, October 4, 8, 14, and 19, the last being 38 days before harvest. Total amount of spray applied was calculated to be 310 gallons per acre.

Mature-green fruit were picked on November 26, December 8, and 30. Samples for yield determination were obtained from a 280-foot section of a representative row selected near the center of each plot. An additional sample of from 140 to 175 fruit was obtained in another area of each plot. All samples were picked by one man. From these samples, percentage of fruit infected with bacterial spot, average size of individual fruits, and per acre yields were calculated.

The field was severely damaged by frosts on December 22 and 23; this resulted in considerable defoliation and loss of fruit by sunburning. Comparison of result obtained from the first two pickings with the third indicated the frosts had no significant effect on the outcome of the experiment except to lower total yield.

Plots treated with the antibiotics produced larger yields of larger fruit with less bacterial spot infection than the untreated plots (Table 1). Compared to the average of two untreated plots, bacterial spot infection was reduced 67 percent and 28 percent, and average fruit size was increased 12 percent and 7 percent, for plots sprayed respectively with 200-20 ppm. and 100-10 ppm. streptomycin-Terramycin. The 200-20 ppm-sprayed plot showed an increase of 50 percent in yield of bacterial spot-free tomatoes and 25 percent increase in total yield. Corresponding figures for the 100-10 ppm. -sprayed plot were 22 percent and 10 percent.

Control of bacterial spot on the foliage was not measured quantitatively; however, observations at harvest indicated that from 4 to 8 leaves were lost on most untreated plants as a consequence of bacterial spot infection. Plants in the plot sprayed with 200-20 ppm. streptomycin-Terramycin showed almost no defoliation and the 100-10 ppm. plot was intermediate between the two. These differences were readily apparent; persons with no pathological training determined without error the outside rows of treated plots.

EXPERIMENT II

This experiment was conducted in a 75-acre field set with plants of the Homestead variety about October 10, 1954. Thirty-two rows along one side of the field were set with bacterial spot-infected transplants. The remainder of the field was set with transplants apparently free of bacterial spot[6]. Plots were located in both areas, thus giving an opportunity to evaluate

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[5] Agri-mycin 100, an agricultural formulation containing 15% streptomycin and 1.5% Terramycin, was provided for use in these experiments by Chas. Pfizer & Company, Inc.

[6] These transplants were obtained from plantbeds sprayed regularly with streptomycin-Terramycin and careful examination revealed no evidence of bacterial spot in the plantbeds.

Table 1. Effect of streptomycin-Terramycin sprays on incidence of bacterial spot, size, and yield of mature-green tomatoes in Experiment I.

Treatment	No. fruit examined	Fruit infected with bacterial spot (%)	Average size (ozs.)	Yield, crates (60 lbs.)/A.	
				Bacterial spot-free	Total
200-20 ppm. streptomycin-Terramycin	3683	8.5	5.63	512	554
100-10 ppm streptomycin-Terramycin	3538	18.3	5.40	416	488
None (Avg. of two plots)	3306	25.4	5.04	341	444

effectiveness of the sprays in checking development of bacterial spot on infected plants, and also in preventing its spread to healthy plants. Plots sprayed with antibiotics were 12 rows wide and approximately 1,000 feet long, an area of about 1.7 acres. Untreated plots, 5 to 12 rows wide, separated and bordered all treated plots. The untreated plots between the two areas were side by side.

The cooperator applied maneb and zineb alternately on a weekly schedule to control fungus diseases; parathion and DDT were used to control insect pests.

The seven streptomycin-Terramycin sprays -- applied on October 20, 29, November 3, 10, 17, 24 and December 1 -- ranged from 40 to 90 gallons per acre per application. Total amount of spray applied was calculated to be 465 gallons per acre.

Tomatoes were picked in the mature-green stage by commercial picking crews. Part of the area was picked on December 8, but picking was discontinued when the grower realized the fruits were immature. The figures obtained from this partial picking were added to figures obtained on December 20 when the entire area was picked. Other pickings were made on December 30 and January 12. At each picking, samples averaging approximately 150 fruits each were selected at random from three locations in each plot and used to determine incidence of bacterial spot and fruit size. Due to an oversight by the cooperator, yield records were not obtained.

Results of this experiment are summarized in Table 2. Plots sprayed with 200-20 ppm. streptomycin-Terramycin had 72 percent less bacterial spot-infected fruit than adjacent checks in the area set with diseased transplants, and 85 percent less in the area set with healthy transplants. Use of sprays at 100-10 ppm., applied to healthy transplants, resulted in 74 percent less bacterial spot on the fruit than was present on adjacent checks and gave slightly better control than 200-20 ppm., applied to diseased transplants. The results also show that percentage of bacterial-spot-infected fruit varied inversely with the distance from the area set with diseased transplants. This effect was especially noticeable in the remainder of the field not in the experiment, the more distant parts having only occasional fruit infected with bacterial spot.

Fruit size was not affected by any treatment in this experiment. However, it became apparent during the first picking that fruits from treated plots were less cracked and wind-scarred than from untreated plots. This was measured in the area set with diseased plants. Forty-three percent of the fruit of check plots were cracked or scarred, whereas 26 percent were so affected in the treated plot, a reduction of 40 percent.

DISCUSSION

The results of experiments reported herein indicate streptomycin-Terramycin sprays are useful as a control of bacterial spot in the field. While bacterial spot may be brought under control by large dosages, as indicated by Coe, it is evident that streptomycin-Terramycin sprays are most effective when applied to prevent the disease. It is also clear that efficacy of the treatment is enhanced when supplemented by practices which tend to discourage development of bacterial spot or to delay its appearance in the crop. Use of disease-free transplants, picking the fruit while the vines are dry, and planning the crop to avoid as much of the rainy season as possible are particularly important in this respect.

Table 2. Effect of streptomycin-Terramycin sprays on incidence of bacterial spot and size of tomato fruit in Experiment II.

Treatment*	No. fruit examined	Fruit infected with bacterial spot (%)	Average fruit size (ounces)
In area set with bacterial spot-infected transplants			
Untreated	3594	29.0	4.45
200-20 ppm. streptomycin-Terramycin	3893	8.0	4.56
Untreated	2539	28.3	4.55
In area set with healthy transplants			
Untreated	2471	28.3	4.80
200-20 ppm. streptomycin-Terramycin	2702	3.8	4.74
Untreated	1922	23.7	4.59
100-10 ppm. streptomycin-Terramycin	1978	5.7	4.61
Untreated	2009	20.6	4.61

*Listed in order of occurrence on field.

Table 3. Effect of picking condition on the incidence of bacterial spot on tomato fruit.

Treatment	Percentage of fruit infected with bacterial spot		
	1st picking	2nd. picking	3rd. picking
Experiment I, fruit picked while vines were wet			
200-20 ppm.	1.4	7.5	16.7
100-10 ppm.	10.8	15.8	28.2
Untreated	18.9	25.7	31.6
Experiment II, fruit picked while vines were dry			
Untreated	36.3	29.3	21.5
200-20 ppm.	13.0	7.1	4.0
Untreated	39.0	26.0	19.9
Untreated	32.1	28.5	24.4
200-20 ppm.	5.8	4.3	1.5
Untreated	40.8	17.3	13.0
100-10 ppm.	11.8	3.6	1.6
Untreated	36.6	15.1	10.2

Control of bacterial spot in Experiment I probably was somewhat better than is indicated by the figures in Table 1, which are for the entire yield. The cooperator picked the fruits while the vines were wet with dew. As a consequence, percentage of infected fruit in all plots increased rapidly with each picking (Table 3). In contrast, percentage of infected fruit declined sharply with successive pickings in Experiment II where the plants were picked while the vines were dry. In both cases, the weather was dry and unfavorable for natural spread of bacterial spot. Therefore, the results of the first picking in Experiment I are a better indication of bacterial spot control actually obtained from the treatments than the figures for the entire yield, which reflect an unnatural spread of the disease after the treatments were ended. These same results also indicate clearly that streptomycin-Terramycin used with success during one period of disease activity does not offer any protection, at least to the fruit, during a subsequent infectious period except as might be realized from a reduction of inoculum.

In comparing results of the two experiments, it is noted that an increase in average fruit size occurred in one experiment, but not in the other. Also, in the latter case a reduction in cracking and scarring of the fruit was observed. In the writer's opinion, these somewhat unexpected results were related to control of defoliation caused by bacterial spot -- the different results being determined by field conditions in the two experiments. In Experiment I, the large yield (600-700 bushels per acre including unharvested fruit lost as a result of frost) taxed the capacity of the foliage to size the fruit. Consequently the extra foliage present on treated plants was reflected in larger fruit. On the other hand, in Experiment II, the yield (195 bushels per acre according to the grower's records) was limited by conditions other than the diseases present. Thus the extra foliage on treated plants did not result in an increase in average fruit size. However, in this field cracking and scarring of the fruit was severe and the extra foliage around the bottom of treated plants provided enough protection to the fruit so that these injuries were reduced. The writer has no evidence which indicates that these benefits resulted from a direct or stimulating effect by the antibiotics on the plant, nor is it suggested that they are to be expected in each instance of use, but is is interesting to note that indirect benefits of considerable consequence may occur as a result of bacterial spot control.

Use of streptomycin sprays for bacterial spot control in tomato plantbeds is estimated to cost from $1 to $3 per acre for plants set in the field. This cost is entirely economical. Results of experiments herein reported suggest that streptomycin sprays can be economically used in the field also by adapting the control program to the interval when the disease is most likely to spread rapidly. In Experiment I, the cost of the antibiotics at 1954 prices applied at 200-20 ppm. was calculated to be $49.60 per acre. It is obvious that the increase in yield, reduction in infected fruit and increased fruit size obtained would have made this investment a profitable one for the winter grower of mature-green tomatoes.

In Experiment II, cost of the materials applied at 200-20 ppm. was calculated to be $74.40 per acre. Since yield records were not obtained in this experiment, benefit from use of the antibiotics cannot be assessed with accuracy; however, the increase in the marketable portion of the crop, an accruement due to less cracked, scarred and infected fruits amounting to an estimated 20 to 25 bushels per 100 bushels of yield, was more than sufficient to pay the cost of materials used.

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COMPATIBILITY BETWEEN STREPTOMYCIN AND COPPER IN THE CONTROL OF BACTERIAL SPOT OF PEPPER[1]

R. S. Cox

In repeated tests during the 1954-55 season weekly applications of streptomycin formulations gave commercial control of bacterial spot of pepper (Xanthomonas vesicatoria). Bi-weekly applications were less effective. In a dosage series of 100 to 1000 ppm, effectiveness, as measured by disease severity, increased up to 400 ppm. Yield increases were as much as 50 percent over that of the checks. The lowest effective dosage was 200 ppm.

The neutral coppers (tribasic copper sulfate and Copper A) also provided an effective degree of control as measured by foliar disease severity. These materials were completely compatible with streptomycin, and there appeared to be a considerable additive effect when they were used in combination (2 to 4 pounds of neutral copper (approximately 50 percent active) with 100 to 200 ppm of streptomycin).

Other fungicides (nabam + zinc sulfate, zineb, captan, ziram, and maneb) were ineffective against bacterial spot but did not appear to reduce the activity of streptomycin when used in mixture with it.

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[1] [NOTE- Through an unfortunate editorial lapse this brief independent article was printed in the June Reporter, pages 485-486, as a summary to the entirely separate paper, also by Dr. Cox, "Compatibility between a streptomycin -Terramycin formulation and copper in the control of bacterial blight of celery," pages 484-485. The Reporter regrets the confusion caused by this error].

DEVELOPMENT OF SWEETPOTATO SCURF IN STORAGE[1]

Robert H. Daines

With the introduction into New Jersey of storage houses in which a high humidity is maintained during both the curing and holding periods, the question of whether scurf, Monilochaetes infuscans, develops during storage, and if so, under what conditions, has received considerable interest. To determine the extent of scurf activity in various storage environments, the following tests were conducted.

Experimental

Sweetpotatoes showing scurf were stored in each of two houses, one having a low relative humidity (approximately 65 to 75 percent), and one in which a high humidity was maintained (85 to 90 percent). In the high-humidity house, one lot of sweetpotatoes was sprinkled with water to keep them damp. The other potatoes in this house were not kept damp.

Before storage, the margins of visible scurf were designated. In February, 1955, the sweetpotatoes in the low-humidity storage house were examined. It was found that the scurfed areas had not enlarged. However, enlargement of some spots had occurred on the dry sweets in the high-humidity house, and all that were wet in this house showed advancement of the disease during the storage period. In fact, many of the sweets in this treatment became completely discolored.

In an additional test, sweets not showing the disease, but harvested from a field where scurf was a problem, were stored in the above-mentioned houses together with sweetpotatoes taken from a field where scurf had not been found for 3 or more years. In February, when the potatoes were taken from storage, all those stored in the low-humidity house were free from visible scurf. Those stored in the high-humidity house where the sweetpotatoes were kept free from visible moisture presented a good appearance, so far as scurf was concerned. However, on examination it was found that 20 percent of the sweets that came from the field where scurf was a problem showed the disease. The roots that were wet during storage were badly scurfed. The sweetpotatoes grown in the field that was free from scurf, even though wet during much of the storage period, remained free from scurf.

Summary

These studies indicate that scurfed areas on sweetpotatoes may enlarge and new ones appear during storage in houses where the relative humidity is maintained at a high level. This is especially true if environmental factors allow the roots to become wet at times during the storage period. However, no evidence was secured to indicate that scurf develops in houses having a low humidity.

Sweetpotatoes taken from a field that was free from scurf remained disease-free during the storage period regardless of the humidity employed. Since they were stored in hampers placed alongside hampers holding scurfed sweets, it is apparent that scurf did not spread from hamper to hamper during the storage period.

The information presented here indicates that where high-humidity storages are in use, the successful control of scurf is of increasing importance.

NEW JERSEY AGRICULTURAL EXPERIMENT STATION, NEW BRUNSWICK

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, the State University of New Jersey. Department of Plant Pathology, New Brunswick.

A COLOR REACTION WITH SULFITE SHOWN BY SOME VIRUS INFECTED PLANT TISSUES

C. E. Yarwood

Many color reactions of virus-infected plant tissues are known but to the writer's knowledge, the sulfite reaction has not been reported.

When 0.5% to 10% Na_2SO_3 in water was added to a freshly ground water suspension of mosaic-infected tobacco leaves, an Acajou Red (Ridgway) color appeared in the mixture, but disappeared in a fraction of a second or in a few seconds. The property of giving this reaction was quickly lost when the tissue suspension was allowed to stand before testing, but in one trial was retained to a detectable degree for 30 minutes. Healthy tissues usually did not give the reaction but on some occasions healthy tobacco tissue gave a slight color reaction of the same type. Other reducing agents (stannous chloride, hydroxylamine, and ascorbic acid) gave no such reaction. When the mosaic tobacco tissue was ground in 95% C_2H_5OH, 1% KOH, 1% HCl, or 1% ascorbic acid, no color reaction with sulfite resulted.

Only four virus infections (tobacco mosaic virus in tobacco, apple mosaic virus in tobacco, tobacco ringspot virus in tobacco, and a virus from peach yellow bud mosaic in sunflower) showed the reaction. Sugar cane mosaic virus in corn; peach yellow bud mosaic virus in bean, cowpea, and cucumber; and broad bean mosaic virus in broad bean; did not show the reaction. Purified tobacco mosaic virus did not show the reaction. The fact that ground tissue which had stood a few minutes did not show the reaction also supports the idea that the reaction is not due to the virus *per se*.

No suggestion is made that this is a good method of diagnosing virus infections. The reaction is apparently an indication of some undetermined change in host composition caused by certain virus infections.

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EFFECT OF STORAGE TEMPERATURE ON DEVELOPMENT OF INTERNAL CORK IN SWEETPOTATO ROOTS[1]

W. J. Martin

SUMMARY

Results of experiments in Louisiana on the effect of storage temperature on the development of Internal Cork lesions in Porto Rico sweetpotatoes have verified results reported by others that there is rapid increase in incidence and severity of lesions during storage at 70°-80° F, and that there is little or no increase during storage at 50°-60°.

In addition the following new information was obtained from the tests reported herein:

1). In roots which had been stored at 50° or 60° F for about 150-200 days, then removed and placed at 80° storage, there was little or no increase of cork lesions during a period of 14 days at 80°. During a period of 36 days at 80° there was some increase in cork lesions, but the incidence and severity was still low compared to that in roots held at 80° since harvest. During a period of 58 days after removal from the cooler storages, the cork lesions had increased to a level near that in roots which had been stored at 80° since harvest. These results suggest that there would be adequate time for the process of marketing roots, between the time of removal from cold storage and the time of severe increase in the amount of cork lesions.

2). While there is no increase in cork lesions in roots held at 60° F, there appears to be a definite increase in roots held at 65°.

There have been several reports concerning the effect of storage temperature on the development of the characteristic lesions in sweetpotato roots affected with the Internal Cork Virus. (1, 2, 3, 4). These reports indicated comparatively little, if any, increase in the incidence or severity of the lesions in roots stored at 50° to 60° F. There was, however, a great increase in both incidence and severity in affected roots stored at 70° or at higher temperatures.

The object of this paper is to record results of two experiments made in Louisiana on the above subject. The first experiment was made in 1951-52 to determine the rate of increase in cork development in the virus-infected roots after removal from storage at 50° and 60° F and then kept at room temperature. The second experiment was made to compare critically the development of the lesions in roots stored at four different temperatures.

In these experiments the roots were examined for cork by cutting them into slices about 1/8 inch thick, and each root was classed into a class from 0 to 3 depending upon severity of the lesions. Based on this classification a disease index was determined, in addition to the percentage of affected roots, for each treatment.

EXPERIMENT I

Roots for this experiment were produced from plants obtained from cork-affected roots of the Porto Rico variety in 1951. At harvest, a sample of roots was cut to determine extent of the disease at that time, on November 9, 1951.

Four bushels were packed and held at 85° F for 8 days. On November 17 two bushels were placed in 60° storage, one bushel was placed at 50° storage, and one bushel at 80° storage. The roots were removed from these storage temperatures and examined for cork at varying intervals as shown in Table 1. The results of this experiment indicated the following:

1). There was little or no increase, over that occurring at harvest, in the incidence or severity of cork lesions in the roots stored at 50° and 60° F.

2). There was a striking increase in incidence and severity of cork lesions in roots stored above 80°F.

3). There was little or no increase in incidence and severity of cork lesions in roots held for 14 days at 80° F after removal from the 50° or 60° storages.

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[1] Acknowledgement is made to the following who have contributed to this study: George Feazell, graduate assistant in Plant Pathology, for help in examining roots in the early test; E. H. Floyd, Associate Entomologist at Louisiana State University for furnishing the roots used in the 1954-55 test; and to the Department of Horticulture at Louisiana State University for furnishing the controlled temperature storage for the 1951-52 test.

Table 1. Percent cork-affected roots and disease index[a] in sweetpotato roots under different storage conditions in Louisiana 1951-52.

Storage temperature (°F)	Days in storage	Days held at 80°F after removal from storage	No. roots examined	Disease index	Percent corky roots
At harvest	0	0	60	17.9	33.3
Over 80°	157	0	25	71.0	88.0
"	214	0	20	82.5	95.0
"	250	0	50	97.5	100.0
60°	157	3	50	18.5	32.0
60°	157	58	25	72.0	88.0
60°	157	71	20	77.5	85.0
60°	157	93	53	76.4	90.6
60°	214	1	50	23.5	36.0
60°	214	14	20	22.5	40.0
60°	214	36	32	32.0	46.9
50°	214	1	50	23.5	40.0
50°	214	14	20	12.5	25.0
50°	214	36	25	34.0	48.0
50°	214	57	37	44.6	64.9

[a] Disease index was determined by the following formula, after classing each root into one of the four classes (0 = no cork; 1 = slight cork; 2 = moderate cork; and 3 = severe cork):

$$\frac{\text{No. roots in each class x class number}}{\text{No. roots classed x 3}} \times 100 = \text{Disease index}$$

Table 2. Mean[a] percent corky roots and mean disease index in sweetpotato roots held at four storage temperatures for 19 weeks during 1954-55 at Baton Rouge, Louisiana.

Storage temperature	Percent corky roots	Disease index
80° F.	83.55	73.58
70° F.	75.30	69.13
65° F.	42.53	30.13
60° F.	24.38	14.93
L.S.D. 5%	16.53	14.12
L.S.D. 1%	22.89	19.56

[a] Mean of four replicates with 75 roots per replicate (bushel).

4). There was a definite increase of cork in roots held for 36 days at 80° F after removal from 50° or 60° storages. However, incidence and severity was still low compared to that in roots held at 80° since harvest.

5). In roots held for about 58 days after removal from 50° and 60° storages, the incidence and severity of the cork lesions had increased to a level near that in roots which had been stored at 80° since harvest.

EXPERIMENT 2

This experiment was made to compare critically the development of cork lesions as affected by four different temperatures, as follows: (a) Common storage, never below 75°, mostly 80° F, (b) Constant 70°, (c) Constant 65°, (d) Constant 60°.

Four replicates, consisting of one bushel of US #1 roots each, were used, making a total of 16 bushels of roots. One bushel was examined at harvest, revealing 30.0 percent corky roots with a disease index of 17.0. The 16 bushels used in the experiment were kept at room temperature for 10 days to effect curing. Then they were placed at the different temperatures on October 27, 1954. On March 14, 1955, the roots were cut and examined for cork. The results are given in Table 2.

The results of this test indicate that:

1). Internal cork lesions increased about equally during storage at 70° and 80 °F.

2). There was little or no increase in number and size of lesions during storage at 60° F, but there was some increase at 65°.

3). The increase in incidence and severity of internal cork lesions during storage at 70° F was strikingly greater than the increase during 65°storage.

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GUAR AS A LOCAL LESION HOST OF POTATO VIRUS S

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Potato virus S[1] is at present diagnosed by serology and by the electron microscope[2]. A local lesion host would be useful. Tomato, tobacco, sunflower, cucumber, bean, broad bean, cowpea, and guar were inoculated with juice from U. S. D. A. potato 41956 which has been shown to carry virus S. Only guar (Cyamopsis tetragonoloba) cotyledons showed symptoms. Necrotic lesions (Fig. 1) 45 to 300 microns in diameter appeared within 2 days. The smaller of these lesions were barely detectable with the unaided eye and a dissecting binocular was necessary to make a reliable count. Some of the lesions appeared to involve only a single epidermal cell. Similar inoculations on guar with potato virus X in Nicotiana glutinosa, and with juice from S-free potato seedlings, yielded no lesions. Inoculation of virus S to guar resulted in lesions in each of 6 trials. In one trial 1058 lesions formed on 96 guar cotyledons which were dusted with carborundum and brushed with 1% suspension of 41956 leaf tissue as inoculum. Transmission was not clearly aided by quick tissue inoculation or by phosphate or sulfite in the inoculum.

FIGURE 1. Lesions of potato virus S on guar cotyledons. Inoculated November 24, photographed November 29, 1954. x about 2 1/4.

As further evidence that the lesions on guar were infections of virus S, juice from these lesions was examined in the electron microscope. Preparations for examination were made by cutting lesions from inoculated guar leaves and grinding 5 to 10 lesions in an amount of water estimated to give approximately 100-fold dilution. Polystyrene latex was added to the homogenate for size calibration and the mixture was sprayed on to collodion-coated screens. Similar preparations were made from uninoculated guar leaves, and from inoculated leaves outside the lesions. On examination in the electron microscope, rod shaped particles were observed in the preparations from guar lesions resulting from inoculation with S virus. No such particles were observed in the control preparations. The number of particles observed was too small for a statistically satisfactory size estimate, but the particles appeared to be of the same shape and size as those found in U. S. D. A. potato 41956 (16 x 680 millimicrons).

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SYMPTOMS OF VIRUS RING SPOT AND RELATED DISORDERS IN THE SWEET CHERRY ORCHARDS OF IDAHO[1]

A. W. Helton[2]

First information concerning an unknown problem often suggests, erroneously, that the cause and effect relationship can be established with reasonable ease. So it has been in sweet cherry orchards with the viruses that have been grouped thus far under the loose name, "ring spot".

Early in the investigations dealing with these viruses, there were good indications that varietal effects and strain relationships would fall within a fairly well stabilized pattern, lending itself to experimental resolution with a minimum of difficulty. Such a dream has not yet been realized. Rather, the more extensive the investigation, the more complicated the result.

It is reasonable now to suppose that the environmental factor will prove to be decisive rather than incidental in governing strain and host relationships within this "ring spot complex" in stone fruits.

Investigations in Idaho dealing with ring spots and related phenomena are hardly underway, yet many symptom peculiarities already have become prominent in field observations. Virus and virus-like symptoms found in Idaho sweet cherry orchards are being summarized in the following, therefore, as a preliminary report for the benefit of those engaged in similar investigations elsewhere.

THE LINE PATTERN SYMPTOM

In Idaho there are many variations of a chlorotic line symptom. It is often found only as a jagged line forming an otherwise symmetric V-shaped pattern in the terminal portion of the leaf. In such cases the chlorosis usually is so pale that a successful photograph is extremely difficult to obtain.

The next most clearly defined symptom is that illustrated in Figure 1. The chlorosis still is pale, but the arrangement is more randomized, and the lines often orient themselves in single or concentric circles. This concentric arrangement also is illustrated in Figure 1.

Occasionally a ragged line symptom is found (Figure 2) in which the color is a bright yellow. Only rarely does this type approach a circle arrangement. It can be found in the same tree year after year, as is the case also with the two symptom types described above. The severity of the symptom seems to vary with season in each case.

In Figure 3 are shown three leaves seriously affected by a condition which often appears to be a blotchy cross between the line pattern and closed ring symptoms. Sometimes it is mild, sometimes it is moderately prominent, and sometimes it is severe and brightly colored. Its relationship to the symptom illustrated in Figure 2 is not yet known.

THE TRUE RING SPOTS

Circular ring patterns of several kinds are prominent in Idaho orchards. However, variation is so great that the closed circular ring is the only symptomatic characteristic common to all kinds.

Figure 4 shows a very mild chlorotic ring type in which the rings may be anything from perfect circles to irregular circles, and single or concentric. The chlorosis is pale and lacking in prominence. Rarely does the symptom appear over an entire tree at one time.

In most of the ring symptoms found in Idaho there are both chlorosis and necrosis. As illustrated in Figure 5, single and concentric chlorotic rings are most prominent. However, as the season advances, there is a tendency toward necrotic flecking in the chlorotic rings, and occasionally there is some shot-holing. The chlorotic rings of this symptom type generally are of a more constant size and characteristic shape than are the rings described above and illustrated in Figure 4.

Figure 6 illustrates a severe ring symptom in which the rings are entirely necrotic. This is a non-recurrent type apparently, since symptoms have not been located on affected trees the

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[1] Published with the approval of the Director as Research Paper Number 400 of the Idaho Agricultural Experiment Station.

[2] Assistant Plant Pathologist, Idaho Agricultural Experiment Station, Moscow.

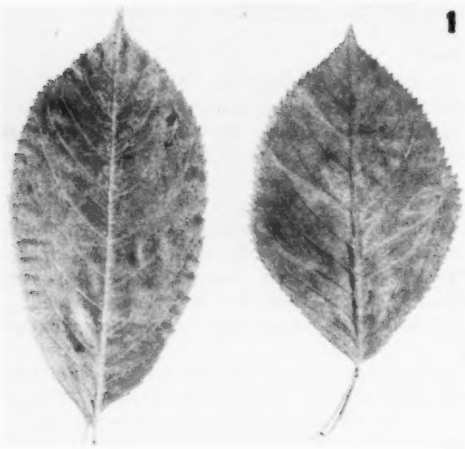


FIGURE 1. Line pattern symptoms in leaves of sweet cherry. The leaf to the left shows only slight discoloration; the leaf to the right shows several pale lines, some of which are oriented in single and concentric circles.

FIGURE 2. Line pattern symptom of brilliant yellow color in a Bing cherry leaf. This is a type in which the lines tend to be doubled and quite ragged as well as bright yellow.

FIGURE 3. Ring-line-blotch symptoms in Bing leaves. The two leaves to the right are severely blotched with chlorotic symptoms which appear more like coalesced lines of broad and diffuse characteristics, whereas the leaf to the left shows some definite rings. This sort of symptom often gives the impression of a cross between line pattern and true ring spot symptoms.

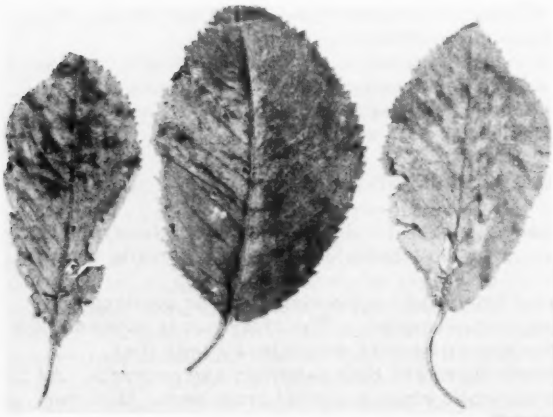
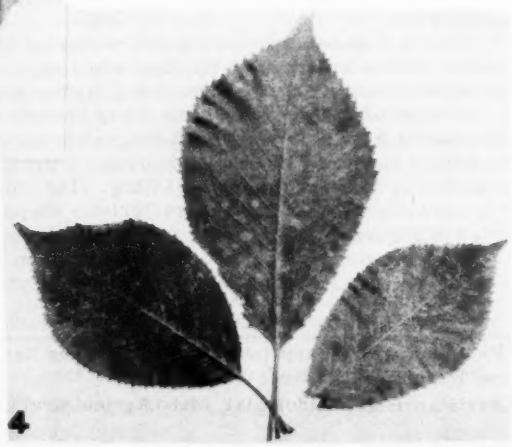


FIGURE 4. Mild chlorotic ring spot symptoms. In the center leaf the pattern is typically single and concentric circles; in the other two leaves the symptoms appear to have characteristics of both line pattern and true ring spot symptoms.



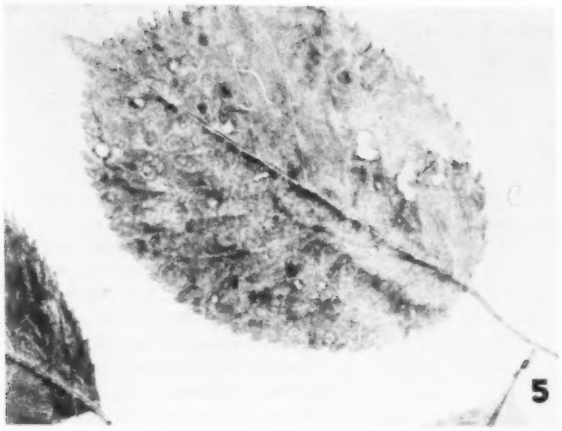


FIGURE 5. Chlorotic and necrotic ring spot symptoms in which the ring symptom is of a characteristic size and arrangement. Necrotic flecking develops in the chlorotic lines and eventually some shot-holing occurs.

FIGURE 6. A severe form of necrotic ring spot which develops without any apparent chloroses. Shot-holing and tattering are common as the season advances.

FIGURE 7. Green ring mottle symptoms in the leaves of Late Duke semi-sweet cherry. The rings in this case are green on a yellow background.

FIGURE 8. Necrotic tatter leaf symptoms are shown in the leaf to the left. In the other two leaves are shown tatter leaf symptoms of obscure cause. Insects sometimes are involved but not always.

FIGURE 9. Necrotic tatter leaf symptoms in a Black Tartarian twig in which each leaf is affected to a a different degree. Often this symptom is caused by a severe ring spot of tatter leaf strain of virus. Sometimes the cause appears to be connected with zinc deficiency and perhaps other conditions. Such tattering develops with or without chloroses, necroses, or rusty mottle-like symptoms.

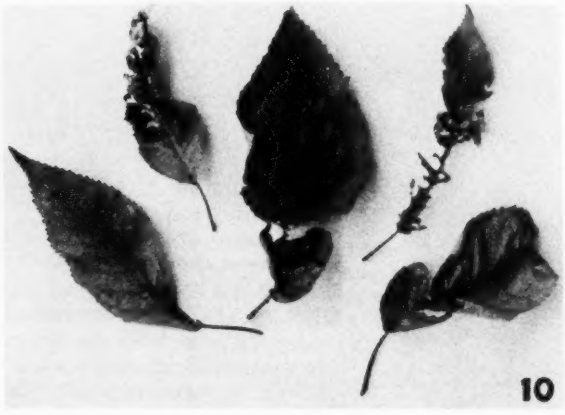


FIGURE 10. A recurrent necrotic tatter leaf symptom in Bing which appears annually. During the three years the tree has been observed, no other symptom has been detected.

year after initial discovery. Necrotic flecks often are scattered randomly among the rings and shot-holing occurs quite commonly.

Typical symptoms of "green ring mottle" are found in semi-sweet cherry orchards in Idaho. Figure 7 illustrates the symptom and shows the similarity of this condition in outward appearance to other ring symptom types. In this case, however, the rings are green on pale or yellow leaves rather than chlorotic or necrotic on otherwise normally green leaves.

TATTER LEAF SYMPTOMS

Many ragged leaf conditions are found in the sweet cherry orchards of Idaho. Sometimes insects are responsible, and sometimes frost damage results in leaf tattering. Occasionally zinc deficiency seems to be primarily responsible for necrotic spots on pale leaves and subsequent tattering. Other similar symptoms are found that are more difficult to explain.

In Figure 8 variously tattered leaves are illustrated, one of which shows serious necrotic spotting of a recurrent viroid type that generally develops shattered leaves. The other two leaves show tattering of more obscure cause, without either prominent chloroses or necroses.

The twig shown in Figure 9 is affected by a recurrent viroid condition of a kind generally considered to be due to a severely necrotic ring spot strain. Twigs often are found with very similar symptoms which doubtfully are due to ring spot infection. Similar twigs often are found on trees which have variously severe chlorotic ring spot symptoms in other portions of the tree. This suggests that, in this case at least, the chlorotic ring spot stage is an intermediate between the healthy and the severely tattered leaf, such as that illustrated in Figure 10. This is a direct contrast to other cases in which necrotic rings and/or tattering develop without the appearance of chloroses.

SUMMARY

Several of the many virus and virus-like symptom types common in the sweet cherry orchards of Idaho are illustrated and described. Descriptions are entirely tentative since investigations on transmission are not complete. They are presented here as field observation data only, and for the information of colleagues. Comments are invited.

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OCCURRENCE OF OAT MOSAIC IN THE LOWER COASTAL PLAIN OF SOUTH CAROLINA[1]

S. J. Hadden and H. F. Harrison[2]

Abstract

Oat mosaic, previously observed only within or very near the limits of the Southeastern Piedmont region, occurred in a fall-sown oat nursery near the Atlantic Coast in lower South Carolina in 1952-53, and recurred with even greater intensity in 1954-55. Approximately a third of the 29 named varieties and of the 48 unnamed selections included in three Uniform Nurseries are rated as being too susceptible for safe growing on infested soil. Wheat varieties and selections grown in the same nursery showed no signs of infection. The implications of possible further spread of mosaic virus in relation to oat breeding are discussed.

Previous Reports

Oat mosaic has recurred regularly in limited areas in the Southeastern States since it was first observed at Auburn, Alabama, in 1943 (2).

McKinney et al. (3) reported results of experiments and general observations on oat mosaic at Auburn, Alabama; Experiment, Georgia; Clemson, Westminster, and Hartsville, South Carolina; and at Statesville and Fallstown, North Carolina. Moseman et al. (4) reported data on cooperative mosaic nurseries grown at certain of those locations, and also at York, South Carolina. All of these points are within the Southeastern Piedmont region, with the exception of Hartsville, South Carolina, which is located about 15 miles south and east of the "fall-line" dividing the Piedmont and Coastal Plain. No report of oat mosaic virus occurring in the lower Coastal Plain has so far appeared in the literature.

Occurrence in Beaufort, County, South Carolina

The purpose of this paper is to report the occurrence of oat mosaic in Beaufort County, South Carolina, in a fall-sown nursery located within about 15 miles of the Atlantic Coast. The implications of mosaic spread in relation to oat breeding will also be discussed, since this occurrence extends the known range of the virus some 165 miles farther into the Coastal Plain region.

A grain breeding nursery comprising about 1 1/4 acres has been maintained on Brays Island Plantation, Yemassee, South Carolina, each year for the past 5 years. Two adjacent fields are used alternately for the nursery. In order to induce maximum build-up of soil-borne diseases, the alternate area not used for the nursery in any particular crop season is sown to oats (usually of a rust-spreader mixture) to be cut for hay prior to maturity. This system permits the uniform cropping of oats on the entire area each year, and eliminates the problem of volunteer plants in the nursery.

In the spring of 1953, severe mosaic was observed for the first time in a roughly circular area about 15 yards in diameter. A portion of the 86 new P. I. oat introductions distributed in 1952 by David J. Ward, of the Section of Cereal Crops and Diseases, U. S. Department of Agriculture, were growing on the worst infested area. Because of the limited distribution of mosaic in the nursery, it was not possible to obtain relative readings on the entire group[3]; however, certain varieties and breeding lines in other parts of the nursery showed symptoms ranging from slight to moderate in degree. Both the apical and eyespot mosaic symptoms described by McKinney (2) were observed, indicating infestation of the affected area by both Marmor terrestre var. typicum McK. and M. terrestre var. oculatum McK.

In the spring of 1955, when the nursery again occupied the same area as in 1953, mosaic recurred with equal intensity in the original spot and seriously damaged susceptible oats over practically the entire nursery field.

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[1] Contribution from the Coker's Pedigreed Seed Co., Hartsville, South Carolina.

[2] Plant Breeder and Assistant Plant Breeder, respectively.

3 Mosaic data observed at Statesville, North Carolina on certain of these P. I. introductions were reported by Earhart and Moseman (1).

None of the approximately 200 varieties and hybrid selections of wheat included in the nursery showed any symptoms of virus infection.

The even distribution of oat mosaic virus made it possible to record infection data on observation rows of entries in the 1955 Cooperative Coordinated Uniform Fall-Sown Oat Experiment, the Uniform Florida-Gulf Coast Oat Experiment, and the Uniform Oat Rust Nursery. Individual mosaic ratings of each of the 77 entries included in 1 or more of the 3 nurseries are presented in Table 1 (pages 630-631).

Practically all of the better varieties currently available for growing in the main part of the southern oat region were included in these three Uniform Nurseries. Any new varieties eligible for release within the next few years are probably represented in the group of unnamed selections. The latter group also includes much of the most recently developed fundamental breeding stock now available for use in current breeding projects. To clarify discussion of the two groups, summarized data on the 77 varieties and selections listed in Table 1 are arranged to show distribution by varietal groups and infection classes, and presented in Table 2.

Table 2. Summarized data on the 77 oat varieties and selections listed in Table 1, arranged to show distribution by varietal groups and infection classes.

Varietal group	Number in infection class[a]									
	0		I		II		III		IV	
Named varieties	11		4		5		4		5	
Unnamed selections	4		18		8		8		10	
				50				27		

[a] See footnote, Table 1.

Discussion

Although some of the named varieties are noncommercial or rust-tester varieties, the fact that almost a third of that group, and over a third of the unnamed selections, were rated as dangerously susceptible (infection classes III or IV), should be a matter of some concern to breeders and pathologists, particularly if the range of the virus should continue to spread.

Oat mosaic, in its extreme manifestation (the rosette reaction), is one of the most destructive diseases the authors have seen in oats. Unfortunately, most of the basic breeding lines carrying factors for resistance to crown and stem rust appear also to possess factors involving susceptibility to mosaic. Of the 77 entries in the three Uniform Nurseries, only two selections (C. I. 6913 and C. I. 7011) possessing adequate combined crown- and stem-rust resistance were rated even moderately resistant to mosaic. These two selections are spring type oats with insufficient winter hardiness for any except the extreme southern part of the fall-sown oat belt.

Although no specific genetic data are available, our observations indicate that reaction to mosaic is inherited independently of reaction to the rusts and smuts. Certain parental material known to be susceptible to mosaic has been used, perforce, in our breeding project as sources of resistance to rust and smut. However, the resultant segregating populations are being screened in early generations to eliminate plants and lines susceptible to mosaic. The potential threat of further spread of mosaic virus into the Coastal Plain emphasizes the importance of such screening procedures where possible.

Table 1. Reaction to mosaic of entries in 3 U. S. Department of Agriculture uniform oat nurseries for 1955, grown on Brays Island Plantation, Yemassee, S. C.

C.I. No.	Variety or selection	Infection class[a]
787	Richland	0
1815	Appler	0
2044	Canuck	III
2053	Markton	II
2144	Minrus	IV
2401	Victoria	IV
2733	Bond	II
3259	Ukraine	III
3522	Landhafer	I
3531	Fultex	I
3855	Stanton Strain 1	III
3923	DeSoto	I
4009	Trispernia	0
4518	Santa Fe	III
4639	Saia	0
4653	Delair	0
4657	Arlington	0
4660	Mustang	II
5207	Southland	0
5371	Alamo	II
5401	Bondvic	0
5864	Clinton x Landhafer: Iowa 49-2357	III
5872	Nortex Strain: Stoneville Ped. Seed Co.	0
5924	Seminole	I
5927	Sac x Hajira-Joanette: N.D. -Ia. 94-78-8-1	I
6537	Clinton x Ukraine: Iowa 49-2166	IV
6571	(Lee-Victoria) x Fulwin	I
6588	Floriland	0
6600	Sunland	0
6639	Andrew x Landhafer: Okla. Abd. 51-1150	II
6642	Nemaha x (Clinton x Boone-Cartier): Ind. 436A2-2-4-2	III
6644	Clinton x Ark. 674: Ind. 461A1-3-41-2	II
6661	Rodney	IV
6662	Garry: R. L. 1692-27	IV
6666	(Hajira-Joanette x C. I. 4383-C. I. 4189) x Landhafer	IV
6701	Clintland	II
6717	(Lee-Victoria) x Fulwin	I
6719	(Victoria x Hajira-Banner) x (Fulghum-Victoria)	III
6729	Nortex x Trelle Dwarf: Stoneville Ped. Seed Co.	0
6740	Wintok x (Clinton^2-Santa Fe)	I
6744	(Victoria x H-J) x (Fulghum-Victoria)	IV
6757	(Fla. 167 x Landhafer) x Southland	0
6765	Minland	IV
6908	Arlington-Delair x Trispernia: Coker 53-29	I
6909	[Landhafer x (Mindo x Hajira-Joanette)] x Andrew: Minn. II-50-65	IV

Table 1. (Continued).

C.I. No.	Variety or selection	Infection class[a]
6912	[Landhafer x (Mindo x Hajira-Joanette)] x Clinton: Minn. II-50-26	IV
6913	(Bond-Rainbow x Hajira-Joanette) x Landhafer: Minn. II-47-25	I
6916	Vicland x [Branch x (Clinton^2 x Santa Fe)] : Wis. x 486-4	IV
6920	Fulghum 2499 x Landhafer: Miss. P37-B-7	I
6921	Letoria x Clinton^2-Santa Fe: Miss. Ab-201	I
6922	(Atlantic x Clinton^2-Santa Fe) x Hajira-Joanette	I
6930	Benton^7 x Landhafer: Ind. 5129	II
6939	R. L. 1273 x Spooner: Wis. x 342-1-1	IV
6977	Victorgrain Resel.: Miss. H.V.R. 41	0
6978	Trispernia x (Clinton^2-Santa Fe): Miss. S. C. 29	I
6985	Atlantic x (Clinton^2-Santa Fe): Md. Sel. 874	I
6986	Victorgrain 48-93: Coker's 1955 B.R.S.	0
6987	(Arlington-Delair) x Trispernia: Coker's C.I. 6908 resel.	I
6993	Fulwin Composite Cross: Tex. 152-50-17	III
6994	Tennex x (Victoria x Hajira-Banner): Tex. 119-50-8	I
6995	Fulwin Composite Cross: Tex. 152-50-21	IV
6996	Letoria x (Clinton^2-Santa Fe): C. I. 6602-5	III
6997	Atlantic x (Clinton^2-Santa Fe): C. I. 6604-10	II
6998	New Nortex x Landhafer: Miss. Delta Sel. 5139-9	I
7011	(Southland-Landhafer) x (Landhafer x Mindo x H-J: 19-11): Ab. 226	I
7012	(Bonda x H-J x Santa Fe) x Southland: Ab. 254	II
7013	(Minn. Sel. 0-200-10) x Southland: Ab. 314	II
7014	(Mindo x H-J x Landhafer: Minn. 48-8) x Southland: Ab. 307	IV
7015	(Mindo x H-J x Landhafer: Minn. 48-8) x Southland: Ab. 308	IV
7016	Letoria x (Clinton^2-Santa Fe): C. I. 6602-16	II
7017	Wintok x (H-J x Bond-Rainbow x Santa Fe): Tifton 8307	III
7018	Atlantic x (Clinton^2-Santa Fe): C. I. 6604-2	I
7019	Atlantic x (Clinton^2-Santa Fe): C. I. 6604-11	III
7020	Clinton x R. L. 1692: Nebr. 521710	II
7021	New Nortex x Landhafer: Delta Sel. 5023-3	I
7022	(Lee-Victoria x Fulwin) x Clinton^2-Santa Fe: Delta Sel. 5104-7a	I
7023	(Mindo x H-J x Landhafer: Minn. 48-8) x Southland: Ab. 310	III

[a] Infection classes: 0 - No observable symptoms.
I - Slight chlorotic mottling.
II - Moderate chlorotic mottling.
III - Severe chlorotic mottling, plants stunted.
IV - Very severe rosetting, very few plants headed.

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DEPARTMENT OF PLANT BREEDING AND AGRICULTURAL RESEARCH, COKER'S PEDIGREED SEED CO., HARTSVILLE, SOUTH CAROLINA

HOST RANGE STUDIES OF THE WHEAT STREAK MOSAIC VIRUS[1]

W. H. Sill, Jr., and Patrick C. Agusiobo[2]

SUMMARY

Various cereal and forage crop plants and grasses, as well as other monocotyledonous and dicotyledonous plants, were inoculated to determine their reaction to the yellow strain of wheat streak mosaic virus, Marmor virgatum var. typicum. Of the crop plants tested only wheat and certain millets were susceptible enough to be damaged severely by the disease. Others such as oats, rye, and barley were infected systemically but not damaged appreciably. Many varieties of corn, Zea mays, were immune in these tests. A small percentage of plants in some varieties were infected systemically but diseased plants were not stunted. Symptoms were generally diffuse, disappearing gradually as the plants aged. Three varieties gave chlorotic local lesions which often coalesced, rapidly developing into systemic infection. The corn varieties susceptible to systemic invasion appeared to be segregating into two classes, systemically susceptible and immune. Reactions of several varieties of teosinte, Euchlaena mexicana, were very similar to corn and are illustrated.

Several other crop plants and important grasses were immune. These included sorghums, Sudan grass, Johnson grass, orchard grass, and others. All monocotyledons tested other than the grasses (32 species in 13 families) and the dicotyledons tested (5 species from 4 families) were immune.

A new local lesion host, Euchlaena mexicana, was found. Attempts to use it and other known local lesion hosts for semi-quantitative virus assays were unsatisfactory. The sugarcane cross (Otaheite x C.P. 1161), which gave local lesions in McKinney's trials, was immune in these tests, as were all other sugar cane varieties tested, both seedlings and cuttings.

A summary (8) of several studies of hosts of the wheat streak mosaic virus, cited herein, indicated the need for more thorough testing of varieties of several crop plants, some important range grasses, and monocotyledonous plants other than grasses. A suitable semi-quantitative local lesion assay host for this virus was needed also. This study was undertaken, not only to extend the host range, but also, if possible, to find such an assay host.

MATERIALS AND METHODS

A wide variety of crop plants, grasses, other monocotyledonous plants, and a few dicotyledonous plants were collected from various sources. Dr. Kling Anderson and Dr. Robert Pickett, both of the Kansas Agricultural Experiment Station, provided seeds of many grasses. Dr. E. V. Abbott of the U. S. Department of Agriculture, Field Crops Research Branch, Agricultural Research Service, Houma, Louisiana, Dr. B. A. Belcher, of the same service located at Canal Point, Florida, and Dr. S. J. P. Chilton, Department of Plant Pathology, Louisiana State University, furnished both sugarcane seeds and cuttings. Species and varieties of monocotyledonous plants were obtained from Dr. O. H. Elmer, Kansas State College, as well as from greenhouses of the Kansas State College departments of Botany and Plant Pathology, and Horticulture. Dr. A. L. Hooker, Department of Botany and Plant Pathology, Iowa State College, provided some corn varieties. Dr. Edwin James, U. S. Department of Agriculture, Field Crops Research Branch, Agricultural Research Service, Regional Plant Introduction Station, Experiment, Georgia, furnished varieties of Euchlaena mexicana and

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[2] Assistant Professor of Botany and formerly graduate student, Department of Botany and Plant Pathology, Kansas State College, Manhattan.

In addition to those listed in the text, the authors wish to thank the following men who assisted in getting needed seed, cuttings, and plants for these studies: W. W. Willis and W. W. Duitsman, of the Kansas Agricultural Experiment Station; Hurley Fellows, of the U. S. Department of Agriculture, Field Crops Research Branch, Agricultural Research Service, located at Kansas State College; David Ward, C. O. Erlanson, and C. H. Wadleigh, of the U. S. Department of Agriculture, Field Crops Research Branch, Agricultural Research Service, located at several stations.

Panicum accessions. Dr. Max W. Hoover, of the same service, located at the Primary Plant Introduction Station, Ames, Iowa, provided corn foreign plant introductions and varieties, Dactylis collections, and sorghum varieties. Dr. R. H. Painter, Kansas State College, Department of Entomology, provided several monocotyledonous plants. Dr. Lloyd Tatum, U. S. Department of Agriculture, Field Crops Research Branch, Agricultural Research Service, located at Kansas State College, furnished Kansas corn varieties, and Mr. H. H. McKinney, U. S. Department of Agriculture, Field Crops Research Branch, Agricultural Research Service, located at Beltsville, Maryland, provided Golden Giant sweet corn. Dr. F. C. Gates, Kansas State College, Department of Botany and Plant Pathology, assisted in the identification of some plants.

With all crop plants and grasses at least two trials were completed, using a minimum of 25 plants per trial and in many cases a larger number. However, with some dicotyledonous species and monocotyledonous plants other than grasses, smaller populations, varying from 4 to 30, were used, depending upon the availability of plants.

Plants were grown in pots and flats in well fumigated greenhouses held at a minimum of 70° F. Most inoculations of monocotyledonous plants were made by the carborundum rubbing method described by McKinney (4). On dicotyledonous and monocotyledonous plants with broad or particularly tough leaves either the familiar glass spatula-carborundum or cheesecloth pad-carborundum method was utilized. All inoculated plants were observed for at least 1 month, and for 2 to 4 months when plants were slow-growing. Reinoculations to seedling wheat were made from any plants failing to show clear symptoms so that possible symptomless carriers and virus-free or immune plants could be detected. Occasional inoculations were made from plants showing symptoms. In all such cases wheat plants inoculated from these sources developed symptoms indistinguishable from the original virus source. Uninoculated healthy controls of each plant tested were held for continued observation. None developed any symptoms whatsoever. One pot of susceptible wheat seedlings was inoculated from each inoculum source to check the virulence of the inoculum and the characteristic symptomatology on wheat. The yellow strain (3) of wheat streak-mosaic virus, Marmor virgatum var. typicum McK., was used in all experiments.

EXPERIMENTAL RESULTS

OATS (Avena): Six varieties of oats were inoculated. These were Cherokee, Clinton, Fulton, Missouri 0-205, Kanota, and New Nortex. All were infected systemically by the virus, the reaction on the whole being mild. This confirmed many field observations made of naturally infected oats. Symptoms were similar to those described previously by McKinney (5) and Slykhuis (9).

BARLEY (Hordeum): Four varieties of barley, Beecher, Dicktoo, Kearney, and Renown, were inoculated. All plants were infected systemically. They developed mild green mosaic symptoms with no stunting. Again, these results confirmed many field observations made of naturally diseased barley and of artificially inoculated barley varieties in field plots. Symptoms were similar to those reported by McKinney (5) and Slykhuis (9).

RYE (Secale): New Dakold rye was reported to be immune by Slykhuis (9). However, our results both in the field and greenhouse proved this variety to be susceptible to systemic invasion by the virus although infection was often erratic. Symptoms when present were a diffuse green mosaic with little, if any, stunting. The symptoms usually disappeared as the plants matured, but infective virus could still be obtained from these symptomless plants. This variety also was infected with several other collections of the virus. Other varieties of rye grown in Kansas, Balbo and common winter rye, have been found naturally infected in the field at various times and have been artificially infected in field plots. A mild green streak and mosaic which disappear as the plants mature are typical.

MILLETS (Various): Seventeen millet accessions were inoculated. Most were infected systemically by the virus, but one was a symptomless carrier and six were immune in these tests (Table 1). Susceptible varieties were found in three major millet types, proso or broomcorn (Panicum miliaceum), foxtail or Italian (Setaria italica), and barnyard grass (Echinochloa crusgalli). Three Pearl Millet varieties, Pennisetum glaucum, were immune. Three varieties tested, P.I. 183332, (E. crusgalli), P.I. 179388 (Panicum miliaceum), and P.I. 180450 (Panicum ramosum), were so susceptible that if infected naturally, losses could be severe. Diffuse green

Table 1. Reaction of millets to inoculation with wheat streak-mosaic virus; 25 plants of each type inoculated in each of two trials.

Accession No.	Species	Source	Reaction[a]	Infected plants (%)
FC 23895	Setaria italica	Germany	MS	100
FC 23902	Setaria italica	Hungary	C	?
PI 163300	Panicum miliaceum	India-2	I	---
PI 170588	Panicum miliaceum	Turkey-10	MStr	80
PI 173754	Echinochloa crusgalli	Turkey-13	I	---
PI 173803	Setaria italica	Turkey-13	MS	100
PI 177543	Setaria italica	Turkey-17	MS	100
PI 179037	Setaria italica	Turkey-18	StrS	100
PI 179388	Panicum miliaceum	Turkey-19	MSStr	100
PI 180304	Setaria italica	India-20	M	48
PI 180450	Panicum miliaceum	India-20	MSStr	80
PI 180484	Panicum ramosum	India-20	M	20
PI 183332	Echinochloa crusgalli	India-22	MSStr	100
PI 195753	Panicum miliaceum	China-32	I	---
FC 32034	Pennisetum glaucum variety Star	United States	I	---
FC 32149	Common	United States	I	---
FC 32138	Texas 7	United States	I	---

[a] Key to reactions:
C - Symptomless carrier
I - Probably immune
M - Mosaic
S - Stunt
Str - Streak

mosaic and mottle were characteristic of most of the millets, but in the more susceptible ones, yellowish mosaic patterns and streaks were more pronounced and considerable stunting was present.

Slykhuis (9) previously reported an Italian millet to be symptomless or immune and Atkinson (1) reported a proso millet to be susceptible.

CORN, SORGHUM, AND RELATED PLANTS: Many varieties of corn, sorghum, and related grasses were tested. Eleven Kansas and other United States varieties of corn, Zea mays L., plus 75 foreign introductions were inoculated. These represented a heterogeneous group from throughout the world, including many open-pollinated and unselected forms. Twenty-five or more plants per variety were inoculated in each of two trials. Three varieties developed local lesions, followed later by faint systemic chlorotic dashes and streaks similar to those described by McKinney (5). Some plants from 28 other varieties developed systemic symptoms after about 10 days, but the percentage of diseased plants was usually low and was never over 57 percent for any variety (Table 2). Stunting, if present, was very slight in all varieties. Symptoms were generally diffuse and gradually became masked with age. No variety appeared to be damaged appreciably by the disease. Most varieties gave no reaction to inoculation and no infective virus inoculum could be obtained from these plants. The results indicated these symptomless varieties to be actually immune. Reinoculations to wheat from single inoculated

Table 2. Reactions of corn varieties to inoculation with wheat streak mosaic virus.

Variety or P.I. No.	Source of pedigree	Type	Reaction[a]	Diseased plants (%)
Country Gentleman		Sweet	I	0*
Dakota White		Field	M	52
Falconer		Field	M	14
Golden Giant		Sweet	LL-M	57*
Midland		Field	M	13
Pride of Saline		Field	M	25
Double x Double F_2	((K6 x K44) (R30 x Wh 205)) ((K55 x T x 4R3) (R17 x K64))	Field	M	25
K1639	(WF9 x 38-11) (K148 x K150)	Field	I	0
K1859	(WF9 x N6) (K148 x K150)	Field	M	13
K2234	(K41 x K55) (K63 x K64)	Field	I	0
K1830	(K201 x 38-11) (K4 x CI. 7)	Field	M	38
162573	Argentina-1	Sweet	M	30**
162575	Argentina-1	Pop	M	23
162702	Argentina-2	Flint	I	0
162927	Paraguay-2	Flint	M	40
162928	Paraguay-2	Flint	I	0
163144	India-2	Flint	LL-M	20
165036	Turkey-5	Pop	I	0
165041	Turkey-5	Flint	I	0
165457	Mexico-5	Dent	I	0
166042	India-6	Dent	I	0
167095	Egypt-8	Flint	I	0
167388	Turkey-7	Flint	M	12
167975	Turkey-8	Flint	I	0
171904	Turkey-11	Rice Pop	M	9
171917	Turkey-11	Pop	M	24
172334	Australia	Dent	I	0
172595	Turkey-12	Dent	I	0
173828	Turkey-13	Dent	I	0
174414	Turkey-13	Rice Pop	I	0
174990	Burma	Flint	M	13
175334	India-14	Flint	I	0
175976	Turkey-15	Rice Pop	I	0
176804	Turkey-16	Pop	I	0
177107	Turkey-16	Sweet	I	0
177115	Turkey-16	Dent	I	0
177590	Turkey-17	Flint	I	0
177596	Turkey-17	Pop	I	0
177617	Turkey-17	Flint	I	0
177618	Turkey-17	Flint	I	0
177621	Turkey-17	Flint	I	0
177624	Turkey-17	Pop	I	0

*Country Gentleman was also symptomless for McKinney (5). Sixty-eight percent of his Golden Giant sweet corn plants became infected as compared with 57 percent of ours.
** Foreign plant introductions in which symptoms were most pronounced.

Table 2. (Continued).

Variety or P.I. No.	Source or pedigree	Type	Reaction[a]	Diseased plants (5)
179131	Turkey-18	Rice pop	M	10
179132	Turkey-18	Sweet	M	40**
179141	Turkey-18	Pop	I	0
181834	Syria-20	Flint	I	0
181839	Lebanon-20	Pop	I	0
181840	Lebanon-20	Flint	I	0
181988	Yugoslavia-21	Dent	I	0
182323	Turkey-21	Rice Pop	I	0
182324	Turkey-21	Rice Pop	I	0
183752	Turkey-22	Sweet	I	0
183787	Turkey-22	Pop	I	0
184276	Yugoslavia-23	Flint	I	0
185059	Turkey-23	Flint	I	0
185851	Czechoslovakia	Flint	M	10**
185853	Czechoslovakia	Flint-dent	M	24
186187	Uruguay-24	Flint	M	8
186193	Africa-24	Flint	I	0
186197	Australia-24	Dent	I	0
186204	Palestine-24	Dent	I	0
186208	South Africa-24	Flint	I	0
186211	Peru-24	Flint	I	0
186222	Argentina-24	Flint	I	0
186233	Australia-24	Dent	I	0
190081	Guatemala-27	Flint	I	0
192946	China-30	Dent	M	16
193430	Hungary-30	Dent	I	0
193434	Rumania-30	Flint	I	0
193438	Rumania-30	Dent	I	0
193652	Ehtiopia-30	Flint	LL-M	20
193656	Ethiopia-30	Dent	M	46
193658	Ethiopia-30	Dent	I	0
193903	Ethiopia-30	Flint	I	0
194048	Ethiopia-30	Flint	I	0
195116	Ethiopia-31	Flint	I	0
195741	Ethiopia-32	Flint	I	0
196129	Ethiopia-32	Flint	M	30**
196130	India-32	Flint	M	22
197094	India-32	Flint	M	20
197503	Ethiopia-32	Flint-Dent	I	0
198641	Ohio-33	Sweet	I	0
198741	Afghanistan-33	Flint	I	0
198896	Argentinia-33	Flint	I	0
200198	France-34	Flint	I	0

[a] Key - I = probably immune; M = systemic mosaic; LL = local lesions (in many cases such plants became systemically infected later). Some varieties listed as immune might be systemically infected in low percentage if larger populations were inoculated. These data are based upon inoculation of at least 25 plants and in most cases 50 or more.

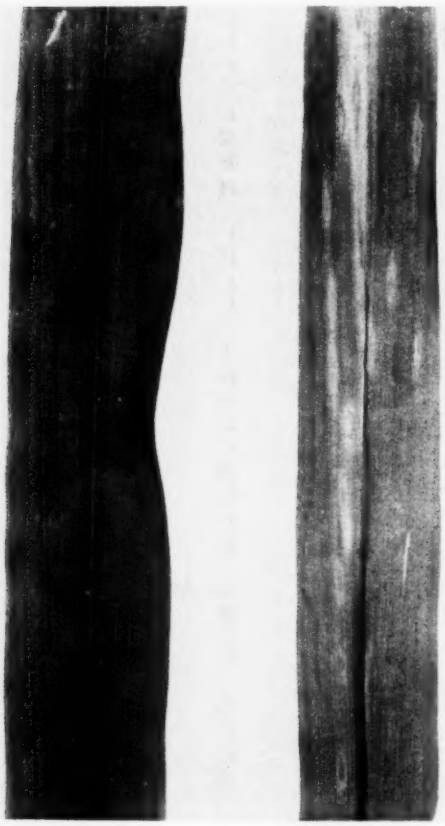

FIGURE 1. Local lesions which develop on some Euchlaena mexicana plants after inoculation with wheat streak mosaic virus. Leaf at left from healthy plant.

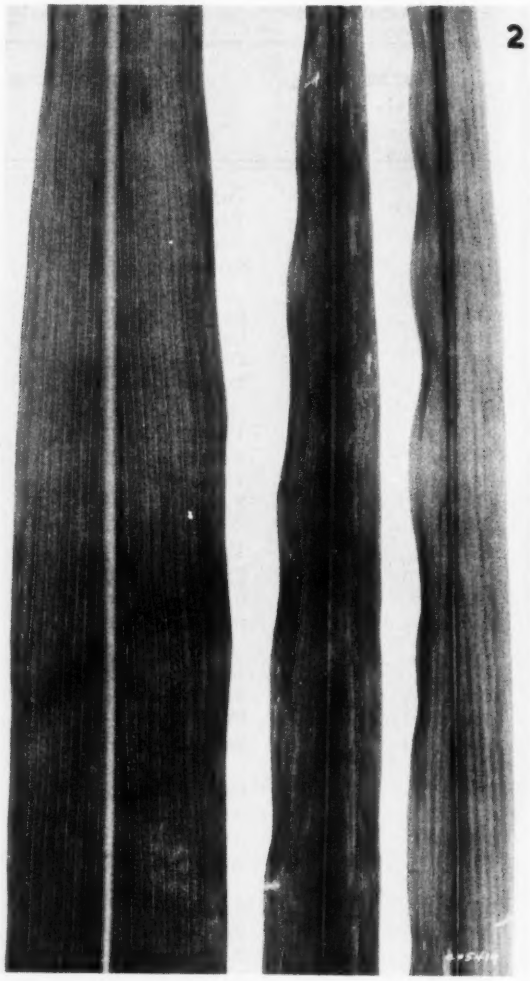

FIGURE 2. Diffuse systemic symptoms which developed on one Euchlaena mexicana plant when inoculated with wheat streak mosaic virus. Left leaf healthy.

but symptomless plants of varieties in which a few plants were infected systemically also gave negative results. In susceptible corn varieties this low percentage of infection appeared to be indicative of a population segregating into two classes, immune and systemically susceptible.

In three experiments 140 plants of a local lesion producing variety, Golden Giant sweet corn, were inoculated. Sixty-eight plants developed local lesions but these were usually scattered and erratic. Plants inoculated when well past the seedling stage usually did not develop these lesions. Twelve of the local lesion plants became systemically infected with the virus, the symptoms consisting of short streaks and dashes, usually diffuse, and masking with advancing age. The local lesions which developed even on seedling plants were so erratic that attempts to use the plants for semi-quantitative virus assay in dilution end point trials were abandoned.

Five Kansas varieties of sorghum, Sorghum vulgare Pers., were tested. These were Atlas, Ellis, Martin, Midland, and Westland. All were symptomless and when reinoculations were made from each to seedling wheat plants no symptoms developed, indicating probable immunity. This agreed with results obtained by other workers with various sorghum varieties (8, 9). Five varieties of Sudan grass (S. vulgare var. sudanense Hitchc.), namely K-2(Johnson grass x 4_n Sudan), Tift, Wheeler, Sweet, and Greenleaf, as well as Sorghum versicolor and S. almum were also immune in these tests (Table 3). Two other species related to corn or sorghum were also immune; these were Job's Tears, Coix lacryma-jobi, and Johnson grass, Sorghum halepense, the latter of which Sill and Connin (8) previously reported to be immune.

Teosinte, Euchlaena mexicana Schrad., a plant closely related to Zea mays, produced local lesions on some plants (Fig. 1), and systemic symptoms on at least one (Fig. 2). The extracts from these diseased plants produced typical wheat streak mosaic symptoms on inoculated wheat seedlings. Also, three other varieties, Teosinte Chalco #1-51A Mex., Orig. Teosinte-Mex. var de Amecameca, and E. mexicana P.I. 162704, furnished by Robert D. Osler of the Rockefeller Foundation, were tested. All developed local lesions on some plants, the remainder being symptomless. Another variety, Teosinte Chalco, showed no visible symptoms but proved to be a symptomless carrier of the virus on several occasions.

Several attempts were made to use the Teosinte local lesion reaction mentioned above in semi-quantitative virus assays but lesion development was too sparse and erratic to be of practical value.

SUGAR CANE: Several varieties of sugar cane, Saccharum officinarum L., were inoculated. These all proved to be immune. No infective virus could be obtained from their tissues and no symptoms were seen even though plants were reinoculated. A list of the seedlings and cuttings inoculated follows.

Seedlings:
(1) Unknown variety.
(2) Cl 41-142 x ?
(3) P.O.J. 2961 x C.P. 49-49.

Cuttings:
(1) Imp. 1178 (Otaheite x C.P. 1161).
(2) Louisiana Purple (B1-24-3).
(3) Chunnee (D1-12-5).
(4) Badila (B1-33-2).
(5) Co. 290 (A3-17-2).
(6) P.O.J. 2878 (D6-7-1).

McKinney (4) reported that the cross (Otaheite x C.P. 1161) gave local lesions but no lesions of any sort were seen in our tests on this cross or any other sugar cane accession inoculated.

IMMUNE GRASSES: The grasses listed in Table 3 were probably immune. They neither showed symptoms when inoculated with the wheat streak mosaic virus, nor induced symptoms of any kind when their extracts were inoculated to wheat plants.

Grasses susceptible to wheat streak mosaic were reported in the following publications (1, 6, 7, 8, and 9). Reactions of various Agropyron x wheat hybrids were reported by Fellows and Schmidt (2) and McKinney and Sando (7). These varied from complete susceptibility in the wheat-like types to immunity in some grass-like types. Some gave local lesions. Several of these local lesion types were tested in this work as possible local lesion assay hosts but lesion production was always erratic.

OTHER MONOCOTYLEDONOUS PLANTS: The monocotyledonous plants listed in Table 4 were also probably immune, since they did not develop symptoms and the virus could not be re-

Table 3. Grasses immune from wheat streak mosaic virus.

Common name	Scientific name	Source or number
Tall oatgrass	Arrhenatherum elatius (L.) Beauv.	FC 29367
Western wheatgrass*	Agropyron smithii Rydb.	From field
" "		FC 2436
" "		FC 23849
Meadow foxtail	Alopecurus pratensis L.	
Smooth brome*	Bromus inermis Leyss.	From field
" "		FC 24678
Orchard grass	Dactylis glomerata L.	From field
" "		PI 189388
" "		PI 184040
" "		PI 174773
" "		PI 172879
" "		PI 170347
" "		FC 24474
" "		FC 24009
Guinea grass	Panicum maximum Jacq.	
Switch grass*	Panicum virgatum L.	
Indiangrass*	Sorghastrum nutans (L.) Nash.	
Pampasgrass	Cortaderia selloana Schult.	
Reed canarygrass*	Phalaris arundinacea L.	From field
" "		KG 2121-51
" "		KG 2190-51
None	P. arundinacea x P. tuberosa	211:42
None	Andropogon ischaemum Thunb.	
Turkeyfoot	Andropogon hallii Hack.	
None	Andropogon sibiricus Steud.	
None	Sorghum versicolor Anderss.	
None	Sorghum almum**	
Job's tears	Coix lacryma-jobi Tourn.	
Johnson grass*	Sorghum halepense (L.) Pers.	
Buffalograss	Buchloë dactyloides (Nutt.) Engelm.	

* Grasses previously reported as immune (8, 9).
** As described by Parodi, L. R. 1943. Rev. of Arg. Agron. 10: 361.

Table 4. Monocotyledonous plants probably immune from the wheat streak mosaic virus.

Family	Common name	Scientific name
Typhaceae	Common cat-tail	Typha latifolia L.
Alismaceae	Giant arrowhead	Sagittaria monte-videnses Cham. & Schlect.
Amaryllidaceae	Amaryllis	Amaryllis sp.
Iridaceae	Walking iris	Iris sp.
	Fleur-de-lis	Iris sp.
	Louisiana Iris	Iris sp.
	Blackberry-lily	Belamcanda chinensis D.C.
	Crocus	Crocus sp.
	Gladiolus	Gladiolus sp.
Cyperaceae	Umbrella plant	Cyperus alternifolius L.
	Nutgrass or Chufa	Cyperus esculentus L.
Araceae	Philodendron	Philodendron sp.
Commelinaceae	Wandering Jew	Zebrina pendula Schnizl.
	Tradescantia	Rhoeo discolor Hance
Liliaceae	Madonna lily	Lilium candidum L.
	Lily-of-the-valley	Convallaria majalis L.
	Grape hyacinth	Muscari armeniacum Leicht.
	Onion	Allium cepa L.
	Ornithogalum	Ornithogalum sp.
	Solomon's seal	Polygonatum sp.
	False Solomon's seal	Smilacina sp.
	Tulip	Tulip sp.
Agavaceae	Bowstring-hemp	Sansevieria thyrsiflora Thunb.
	Soap weed	Yucca glauca Nutt.
Orchidaceae	Lady-slipper	Cypripedium sp.
	Orchid	Orchis sp.
Musaceae	Banana	Musa sp.
Cannaceae	Canna	Canna sp.
	Hallii canna	Canna sp.
	Hungaria canna	Canna sp.
Marantaceae		Marantia bicolor Ker.

Table 5. Dicotyledonous species immune from the wheat streak mosaic virus.

Family	Common name	Scientific name
Piperaceae	Peperomia	Peperomia sp.
Euphorbiaceae	Croton	Codiaeum variegatum Blume
	Redbird-cactus	Pedilanthus tithymaloides Poit.
Crassulaceae	Bryophyllum	Kalanchoë sp.
Moraceae	Rubber plant	Ficus elastica Roxb.

isolated from any of the inoculated plants. Yucca glauca Nutt. and several lily varieties previously were reported as immune by Sill and Connin (8).

DICOTYLEDONOUS PLANTS: Five dicotyledonous species from 4 families also were immune (Table 5). Sill and Connin (8) previously reported 41 species in 20 families as immune.

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PHYSIOLOGIC RACES OF THE LEAF RUST OF WHEAT IN THE UNITED STATES IN 1954

C. O. Johnston and M. N. Levine

Collections of the leaf rust of wheat, Puccinia rubigo-vera tritici (Erikss. & E. Henn.) Carl., were received from 33 States of the United States in 1954. These were analyzed for their physiologic race content. Most of those from the spring wheat States of the upper Mississippi Valley were analyzed at Saint Paul, Minnesota. The remainder were analyzed at Manhattan, Kansas. The collections represented all of the major wheat growing areas of the United States and most of the geographic areas. The only principal geographic area not represented was the New England States.

The data obtained from the study of 1143 isolates obtained from these collections revealed the presence of 37 races of leaf rust in the United States in 1954. Many of the races appeared in very small amounts, however, and some were isolated only once or twice. The data were divided arbitrarily into two groups, those races comprising 1 percent or more of the total number of isolates being classified as major races, Table 1, and the remainder classified as minor races, Table 2.

Although Table 1 lists 20 races as of major importance, only 9 of them, viz., races 5, 11, 15, 35, 54, 58, 105, 122, and 126, were abundant and widely distributed. Race 5 was by far the most important, as it has been in all recent years. It represented 26.2 percent of all isolates and appeared in every State where collections were made except Washington, Oregon, and California. Race 15 was second in importance, comprising 14.8 percent of all isolates. It occurred in all areas except the northwestern and in all but 8 States. It was especially abundant in the southeastern soft wheat area, the central hard red winter wheat area, and the north central hard red spring wheat area.

No other race represented as much as 10 percent of the total number of isolates. Race 105 was third in abundance and was especially important in the soft red winter, hard red winter, and hard spring wheat producing areas. Race 58, the fourth in abundance, was very important in the southeastern States and those States around the Great Lakes and in the north central area. Although races 35, 54, and 122 each represented less than 5.0 percent of the total isolates, they are considered very important because of their virulence on many varieties and their increasing abundance in recent years. They were especially abundant in the southeastern soft red winter and central hard red winter wheat areas in 1954.

Race 11, which long has been the principal race of leaf rust in Mexico and on the Pacific Coast of the United States, continued to increase slowly in the main wheat-producing areas of the United States in 1954. It again was the most important race in the area west of the Rocky Mountains. It also was fairly abundant in some of the southeastern States. Surprisingly, it showed considerable increase in north central and northeastern areas in 1954. Race 93, which has been fairly abundant in the southeastern States was again present in fair abundance in that area in 1954. It was not isolated from collections made in any other area.

It long has been recognized that many races that appear only occasionally are very similar to certain well-known races and may be only variants of the latter. It also is obvious that certain well-known races are similar. For example races 1 and 16 probably are variants of the same race, races 2 and 15 are very similar, races 5 and 52 also apparently are closely related, and it often is impossible to separate races 105 and 126. In a similar manner races 35, 54, and 122 are so much alike that they may appear to have the reactions of one race at the time of one set of readings but of one of the other two races at another time. Therefore the similar races are grouped together under unified race numbers in Table 3. This shows that UN race 5, composed of races 5 and 52, was by far the most important group. UN race 2, composed of races 2 and 15, was second in importance, closely followed by UN 6, composed of races 6, 28, 105, and 126, and UN 13 including races 35, 54, 77, and 122. One of the most interesting points is the low incidence of UN 9 in 1954. The entire group of 6 races comprised a combined total of only 4.7 percent of all isolates and only race 19 reached a prevalence as high as 1.5 percent.

Table 1. Physiologic races of Puccinia rubigo-vera tritici of major importance in the United States in 1954.

Geographic and crop area, and State	Frequency distribution of physiologic races isolated — Physiologic race number																			Major races: Total No. Isolates	Major races: Total No. Race
	1	2	5	6	9	10	11	15	19	28	35	52	54	58	61	93	105	122	126	131		
NORTHEASTERN, SOFT WINTER																						
Illinois	2		3				3	1			1		2								12	6
Michigan	1		8	1			1	6	3		3		1	2			10	2	5		43	12
Missouri			14				1	1			1						1	1	1		20	7
New York			2				2	1			4			9			1		2		21	7
Ohio			2		2			2					3	6					2		17	6
Penn.			2					1						2							5	3
SOUTHEASTERN, SOFT WINTER																						
Alabama			6		1		1	2			9		15	3			6	15	1		59	10
Florida			16			1	2	9	2		1		1	1		3	1	5		3	45	12
Georgia			9	1				7			7		9	1			5	7	1		47	9
Kentucky			3																		3	1
Louisiana			1								1							2			4	3
Mississippi			14	1			3	5	1					2		1	6	1		1	35	10
N. Carolina			6		1	4		5					1	4		2	2	1			26	9
Tennessee			4				3	5			1		4	4		5					26	7
S. Carolina			3							2	3		1	1		1		2	1		14	8
Virginia			5				2	8	1		9			10			2	2	1	2	42	10
W. Virginia			1					1						1							3	3
CENTRAL, HARD RED WINTER																						
Colorado			4	2				2									3		1		12	5
Kansas			41		2	3	2	41	1		2			1			13	6	3		115	11
Nebraska			8					5			1							1			15	4
New Mexico			7	1				3	1				2	2			5	1	20		42	9
Oklahoma			7		3		1	4	1								1		1		18	7
Texas			29	1	1	4	3	16	3	1	1		5	4			11	5	6		90	14
NORTH CENTRAL, HARD RED SPRING																						
Iowa			15		1	1	2	10	1	1			1				6	2	4		44	11
Minnesota	2	15	14				1	14				29		5	2						82	8
Montana	1	1	13							1		1			7			1	2		27	8
North Dakota	2	11	26				4	13		3		7		3	2		1		1		73	11
South Dakota		5	14	2		1	2	6		3		7		2	3				1		46	11
Wisconsin			6	1	1		2	1	2		1			8			9	1	8		40	11
NORTHWESTERN, WHITE WINTER																						
Idaho	1		6	1	1	2	15		1				1	1			2			6	37	11
Oregon							2														2	1
Washington	4						11				1			2				1		2	21	6
SOUTHWESTERN, WHITE SPRING																						
California							4														4	1
Total isolates	13	32	289	11	13	16	67	169	17	11	46	44	46	74	14	12	85	56	61	14	1090	20
Percent of total isolates	1.1		26.2	1.0	1.1	1.4	5.9	14.8	1.5	1.0	4.0	3.9	4.0	6.5	1.2	1.1	7.4	4.9	5.3	1.2	96.3	
	2.8																					

Table 2. Physiological races of P. rubigo-vera tritici of minor importance in the United States in 1954.

Geographic and crop area and state	Frequency distribution of physiologic races isolated — Physiologic race number																	Total No. Isolates	Total No. Races
	4	13	16	20	31	33	37	44	56	57	60	68	77	84	97	143	154		
NORTHEASTERN, SOFT WINTER																			
Missouri		3						1										4	2
Ohio				1														1	1
SOUTHEASTERN, SOFT WINTER																			
Florida		1										8						9	2
CENTRAL, HARD RED WINTER																			
Kansas		1						1										2	2
Texas		1																1	1
NORTH CENTRAL, HARD RED SPRING																			
Iowa														1				1	1
Minnesota	3		1						1	2	1		2		1	2	1	14	9
Montana			1						1				2		1			5	4
North Dakota					1								1			1		3	3
South Dakota									1				1					2	2
NORTHWESTERN, WHITE WINTER																			
Idaho							2	1										3	2
Washington						3		4		1								8	3
Total No. of isolates	3	6	2	1	1	3	2	7	3	3	1	8	6	1	2	3	1	53	17
Percent of total isolates	0.3	0.5	0.2	0.1	0.1	0.3	0.2	0.6	0.3	0.3	0.1	0.7	0.5	0.1	0.2	0.3	0.1	4.9	

Table 3. Percentage of total isolates representing unified race groups obtained from collections made in the United States in 1954, showing the constituent races and the percentage of total isolates each represented.

Unified race number	Constituent races and percentages of each	Percentage of total isolates for the group
1	1(1.1), 16(0.2)	1.3
2	2(2.8), 15(14.8)	17.6
3	44(0.6), 58(6.5), 61(1.2), 84(0.1)	8.4
4	4(0.3)	0.3
5	5(26.2), 52(3.9)	30.1
6	6(1.0), 28(1.0) 105(7.4), 126(5.3)	14.7
7	60(0.1)	0.1
9	9(1.1), 10(1.4), 13(0.5), 19(1.5), 20(0.1), 31(0.1)	4.7
10	11(5.9), 131(1.2), 154(0.1)	7.2
11	93(1.1)	1.1
12	68(0.7), 97(0.2)	0.9
13	35(4.0), 54(4.0), 77(0.5), 122(4.9)	13.4
14	37(0.2)	0.2
16	33(0.3)	0.3
17	57(0.3), 143(0.3)	0.6
20	56(0.3)	0.3

FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, IN COOPERATION WITH AGRICULTURAL EXPERIMENT STATIONS OF KANSAS AND MINNESOTA

CONTROL OF LOOSE SMUT IN OATS AND BUNT IN WHEAT WITH COMMERCIAL FUNGICIDES, 1954-55

R. W. Leukel

In September 1954 seed of Fultex oats, heavily infected with loose smut (Ustilago avenae (Pers.) Rostr)), was treated with several standard and some experimental mercurial fungicides, and planted 8 days later in 5-foot rows, replicated 5 times in outdoor beds at the Plant Industry Station, Beltsville, Maryland. The proper amount of each mercurial with one exception was diluted to 150 cc with water, so that 3 cc of this dilution (or suspension in the case of slurry treatments) provided the recommended dosage for the 250 cc samples of seed to be treated. Other details of the methods employed have been previously described[1].

Data on infection were taken in May 1955. The smutted heads in each row were counted and the total number of heads was either counted or carefully estimated by comparison with the number counted in adjacent rows.

Only 5 of the 14 materials, used on oats, eliminated loose smut completely, while 4 reduced infection to less than 5 percent. The remaining treated lots showed from 8.5 to 26.6 percent infection, compared with an average of 57 percent from untreated seed. (Table 1).

Table 2. Variation in oat-smut control with several fungicides in 2 varieties in different years.

Seed treatments compared			Percent smut infection in						
			Canadian oats				Fultex oats		
No.	Fungicide	Oz./bu.	1951	1952	1953	1954	1954 a	1954 b	1955
1	Check	-	21.8	12.4	8.6	19.0	51.7	25.6	57.0
2	Agrox	1/2	2.4	0.3	0.6	-	13.2	7.0	18.5
3	Ceresan M	1/2	t	0.3	0.1	0.8	0	0.4	0
4	MEMA	1/2	-	0.9	1.2	0.3	2.0	1.3	0.7
5	Panogen	3/4	0	0	0	0.8	0	0	0
6	Setrete	1/2	-	0.9	0.4	1.3	2.1	6.0	15.7

Eight of these same materials had been used in similar experiments in 1953-54 on this same lot of oats. Only three had eliminated smut in the outdoor beds and only one in the more extensive field plots[2]. However, several materials that failed to control oat smut satisfactorily in Fultex oats, had controlled it fairly well in Canadian oats in previous years (Table 2.) The failure of some of these mercurials to control smut satisfactorily in Fultex oats, when applied to the seed at the rates generally recommended for that purpose, indicates that smut control may be more difficult in some varieties than in others. In such varieties it may be necessary to apply these materials at a heavier dosage, or to allow a longer period between treating and sowing.

These same 14 mercurials, along with 5 non-mercurials, were applied also to bunt-infested seed of Purplestraw wheat in October 1954. The seed was sown 11 days after treatment, in 5-foot rows, replicated 4 times for each treatment.

The results are shown in Table 1. Nine of the 14 mercurials eliminated infection by bunt completely, and the remaining 5 reduced it to less than 1 percent. Four of the non-mercurials reduced infection from an average of 83.5 percent from untreated seed to amounts ranging from 0.1 to 1.3 percent. Tritisan (15% penta chloronitrobenzene) applied at the rate of 2 ounces per bushel allowed 19.2 percent infection, while Anticarie (40% hexachlorobenzene) reduced infection to 0.1 percent when applied at only 1/2 ounce per bushel.

[1] Leukel, R. W. 1953. Cooperative tests of seed-treatment chemicals on spring wheat and oats in 1953. Plant Dis. Reptr. 37: 587-594.

[2] Leukel, R. W. 1954. Seed-treatment tests on winter and spring wheat and oats for smut control. 1953-54. Plant Dis. Reptr. 38: 755-759.

Table 1. (A) Emergence and bunt control in Purplestraw wheat, grown from inoculated seed, treated as shown and sown in 5 foot rows, replicated 4 times in plant beds at Plant Industry Station, Beltsville, Maryland.

(B) Effect of mercurial seed treatments on the incidence of loose smut in Fultex oats, sown in 5 foot rows, replicated 5 times.

Seed Treatment					A: Data on Purplestraw Wheat				B: Data on Fultex Oats		
					Percent	Total	Smutted Heads		Total	Smutted Panicles	
Chemical	Form	oz/bu	gr. or cc in 150 cc	cc applied	Emergence	Heads	No.	Pct.	Panicles	No.	Pct.
Check	-	-	-	-	74	1100	934	84.9	1220	720	59.0
Puraseed	slurry	1/2	10	3	79	900	0	0	1229	104	8.5
Agrox	"	1/2	10	3	83	900	1	0.1	1326	245	18.5
Mergamma	"	2	40	3	74	780	6	0.8	1302	303	23.3
Ceresan M	"	1/2	10	3	85	780	0	0	1300	0	0
Ceresan M 2x	"	1/4	5	3	78	760	1	0.1	1200	0	0
Tritisan	"	2	20	6	74	710	136	19.2	-	-	-
Copper Carbonate	"	2	20	6	73	770	10	1.3	-	-	-
Arasan SF X	"	2	20	6	81	800	10	1.3	-	-	-
Anticarie	"	1/2	10	3	76	800	1	.1	-	-	-
Check	-	-	-	-	79	810	665	82.1	1116	614	55.0
Liquid 244	Liquid	1/2	10	3	83	-	0	0	1200	58	4.8
Liquid 365	"	3/4	15	3	86	-	0	0	1207	14	1.2
Panogen	"	3/4	15	3	84	-	0	0	1200	0	0
Panogen 42	"	3/8	7.5	3	82	-	0	0	1200	0	0
Setrete	"	3/4	15	3	84	-	0	0	1175	184	15.7
MEMA	"	3/4	15	3	75	-	0	0	1222	8	0.7
Merculine	"	3/4	15	3	81	850	1	0.1	1137	303	26.6
Vancide	"	4	80	3	82	850	4	0.5	-	-	-
PA - 2N*	"	4	-*	1.6	81	820	4	0.5	1200	0	0
YF 3576	Solution	1/8	2.5	3	84	900	0	0	1205	16	1.3

*Insoluble in water.

Many inquiries are received by the writer regarding the amount of cereal seed that is treated before being sown. The following report from the Agricultural Department of F. H. Peavey and Company attempts to answer this question for certain areas in three States.

1955 Seed-Treatment Survey

During the month of March every year since 1944, Peavey Elevator Managers have been asked to report the percentage of seed grain treated before seeding in their area. The results for the last five years are tabulated below:

	1951	1952	1953	1954	1955
1) NORTH DAKOTA					
Northwest	76%	77%	68%	66%	76%
Southwest	66%	83%	87%	81%	83%
North Central	80%	73%	60%	74%	70%
South Central	63%	69%	66%	68%	68%
Northern Red River Valley	86%	84%	81%	80%	81%
Southern Red River Valley	60%	69%	57%	59%	60%
State Average*	74%	75%	69%	72%	73%
2) MINNESOTA					
Northern Red River Valley	86%	77%	78%	74%	71%
Southern Red River Valley	69%	64%	74%	67%	75%
West Central	65%	61%	52%	64%	60%
Southwestern	56%	59%	54%	53%	60%
State Average*	67%	64%	64%	63%	65%
3) SOUTH DAKOTA					
Northeastern	69%	68%	73%	65%	70%
Southeastern	51%	40%	35%	40%	47%
Central	41%	42%	66%	49%	40%
State Average*	54%	50%	60%	50%	52%
THREE STATE AVERAGE*	68%	66%	65%	65%	66%

*--Weighted

FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, PLANT INDUSTRY STATION, BELTSVILLE, MARYLAND

INFLUENCE OF TEMPERATURE ON THE SUSCEPTIBILITY OF KENAF TO COLLETOTRICHUM HIBISCI POLL.

Thomas E. Summers and James B. Pate

Abstract

Lines of kenaf, Hibiscus cannabinus, reacted with marked differences when inoculated with race 2 of Colletotrichum hibisci at different temperatures. Some lines were completely susceptible at 20°, 25°, and 30°C; other lines were completely susceptible at 20°, affected but not killed at 25°, and were highly resistant at 30°.

The existence of physiologic races of the fungus Colletotrichum hibisci Poll. (3), which is the causal agent of a destructive disease of kenaf, Hibiscus cannabinus L., in Florida and Cuba (2) partially explained the breakdown of resistance in certain kenaf lines which had displayed an apparent resistant reaction when inoculated with a pure culture of the fungus (1). However, inoculation of greenhouse-grown plants in technique studies and of plants grown in the field during the summer and fall of 1954, indicated a difference in reaction for certain lines to race 2 of the fungus under different temperature conditions. The pathogenicity and virulence of the organism used was confirmed by inoculation into susceptible test plants in each case.

To secure definite information concerning the effect of different temperatures on infection and subsequent development of the disease in different lines of kenaf the following study was initiated.

Materials and Methods

Seed of 9 kenaf lines were planted in 4-inch pots in the greenhouse at the Everglades Experiment Station and the plants allowed to grow for 3 weeks. Plants from each line to be inoculated were placed in precision constant temperature chambers at 20°, 25°, and 30°C and held for a 2-hour period prior to inoculation in order to allow the plants to reach the desired temperature. The virulent and destructive race 2 of the fungus was used and inoculations were made by pricking each plant near the growing point (1 inch to 1-1/2 inches below the tip) with a hypodermic needle through a small droplet of the inoculum. The inoculum was composed of spores suspended in sterile water. The inoculated and uninoculated check plants were left in the temperature chambers for 12 hours, after which they were removed to the greenhouse for observation.

Results

Evidence of infection was visible 3 days after inoculation, and definite differences in reaction could be recorded 5 days after inoculation. Plants which were not killed by the disease were allowed to grow to maturity and produced seed.

At 20°C, all plants, except one, became infected and the disease developed to the extent that the entire plant in most cases was killed. There was no appreciable difference between lines at this temperature (Fig. 1, A and D).

At 25° C, the plants of two lines were as severely affected as at 20° (Fig. 1, B); while those of the other 7 lines, though quite severely damaged and stunted in most cases, did survive, and produced lateral branches (Fig. 1, E).

At 30° C, the reaction of the two lines was much more severe than in the remaining 7 lines. The plant of BG-51-7 shown in Figure 1, C, typifies the reaction of the two lines used which were completely susceptible at 30°, while plants of BG-52-7 exhibited a highly resistant reaction, typified by the plant shown in Figure 1, F.

Discussion and Conclusion

The fact that different lines of kenaf react differently to Colletotrichum hibisci at certain temperatures and similarly at certain other temperatures, along with the previously reported existence of physiologic races of the fungus, tends to further clarify the conflicting reactions that certain lines have displayed when subjected to inoculum, either through artificial inocula-

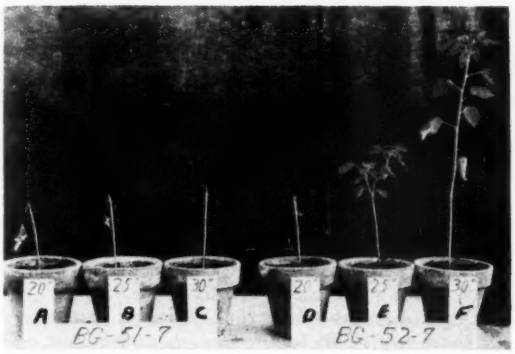

FIGURE 1. Reaction of 2 lines of kenaf to race 2 of Colletotrichum hibisci at 20°, 25°, and 30° C:
A, B, C -- reaction of BG-51-7
D, E, F -- reaction of BG-52-7.

tions or from natural field inoculum, when grown under different temperature conditions.

A more comprehensive study is under way concerning the mechanics of resistance in kenaf as influenced by temperature. It is interesting that in culture the fungus grew more rapidly at 25° than at 20° C (measured diameter of colony), yet more extensive damage to plants was caused at 20°.

Possibly an understanding of the role of temperature in the infection and development of the disease caused by C. hibisci may be of use in determining the feasibility of growing certain lines or varieties of kenaf in any given area where the probable minimum temperature during the growing season is known. The information may also be of use in connection with future breeding programs in which the selection for resistance to this specific disease is a major objective.

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A NEW RACE OF SAFFLOWER RUST

C. A. Thomas[1]

Safflower, Carthamus tinctorius L., is a relatively new oilseed crop in the United States. In the last few years it has been grown on approximately 50,000 acres, mainly in California, as a source of oil for the paint industry.

Rust, Puccinia carthami Cda., is the most serious and prevalent disease affecting the crop in its present area of cultivation. The fact that this rust is easily transmitted by seed and soil-borne teliospores may account for its widespread occurrence. Stand losses resulting from infection of seedling hypocotyls have been serious, particularly where safflower has been grown without rotation (2, 3). The loss in yield of seed and oil from leaf pustules was substantial on irrigated land in Nebraska in 1950, and is thought to be considerable in California when rust develops early in the growing season.

One of the chief objectives of safflower breeding programs in the United States has been the development of rust-resistant varieties. Several sources of resistance have been found in introductions from foreign countries. One of these, N977-16-1, was used by Western Oilseeds Co. in the development of the rust resistant variety W.O. 14. This variety was highly resistant in several variety trials and rust nurseries for the few years it was tested prior to 1954 when it was increased for commercial production. In that year, in one increase field in California, several severely rusted plants were noted by Dr. C. E. Claassen of Pacific Oilseeds Co. Uredospore material was sent to the author for the purpose of determining the possibility of this rust being a new race.

Table 1. Reactions[a] of safflower lines to two races of rust.

Line	Race 1	Race 2	Line	Race 1	Race 2
W. O. 14	1	4	N10	4	4
Pacific No. 1	1	4	N977-16-1	1	4
Pacific No. 2	1	4	N977-15-1	1	1
W. O. 13	4	4	N977-19-1-1	1, 2	4
Indian	4	4	N2555-4	1	4
N1	1	1	N2591-2-10	1	4
N3	4	4	N3664-4-5	0	4
N4	4	4	N3580-4-5	0	4
N5	3	3	N803-19-3	1	1, 2
N6	4	4	A1-5-2	0	2, 3
N8	4	4	Pacific-606-1-1-5	2	2
N9	4	4	PI-181866-2-1	2	1

[a] "0" indicates necrosis or chlorosis without uredia; "1", necrotic or chlorotic areas, a few of which contain small uredia; "2", necrotic or chlorotic areas, most of which contain small to mid-sized uredia; "3", abundant, mid-sized uredia surrounded by chlorotic areas; "4", uredia large and abundant with no necrosis or chlorosis.

[1] Pathologist, Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

Plants of the variety W.O. 14 inoculated with the above uredospores became severely infected. Uredospores were collected from a single pustule and then multiplied by subsequent inoculation of W.O. 14. The rust reactions of several safflower varieties, selections, and introductions to this collection and to the more common race[2] were determined in the greenhouse. One-month-old plants were inoculated by dusting a uredospore-talc mixture on moist leaves. Plants were incubated in a moist chamber at 70° F for 16 hours and then grown in a greenhouse with a mean temperature of 70°. Ratings similar to those described by Simons (4) were made one month after inoculation.

Results of these inoculations (Table 1) indicated that W.O. 14 and several other selections resistant to the common race are susceptible to the new race of rust. At least two races of safflower rust appear to be present. It is suggested that the common race be known as race 1 and the new one as race 2.

It has been shown that the common race is easily transmitted on seed of susceptible varieties by teliospores (1). Tests were made to determine if the new race could be transmitted on seed of W.O. 14. Seeds were infested with teliospores and planted in flats of steamed soil. The temperature was held at 5° C for one week and then raised to 20° C. Counts made one month after planting showed 98 percent of the seedlings infected. Large aecial and uredial lesions developed on stems of W.O. 14 plants when inoculated with teliospores of the new race.

The above results would indicate that this new race could become as damaging to W.O. 14 and other susceptible varieties as the common race is to present commercial varieties. A recent communication from Pacific Oilseeds Co. relates that rust has been observed in 1955 in increase fields of lines resistant to the common race.

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[2] Supplied by D. D. Rubis, Agronomist, U. S. Department of Agriculture, Mesa, Arizona.

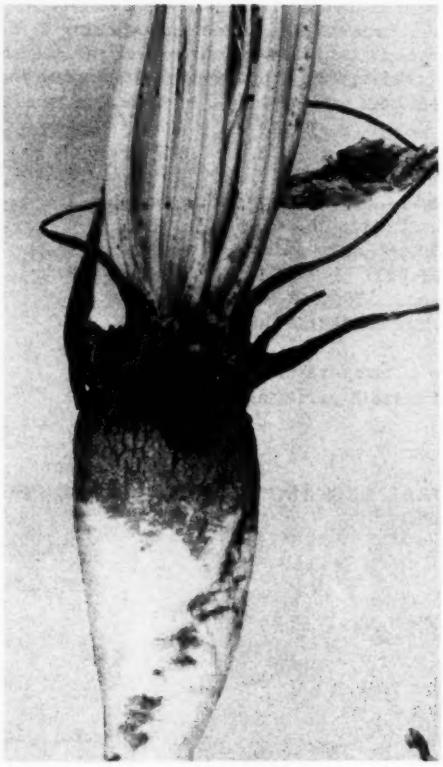
A SCURF OF SUGAR BEETS CAUSED BY CYLINDROCLADIUM SCOPARIUM[1]

Paul L. Lentz[2]

Abstract

Cylindrocladium scoparium, a weak pathogen on various plants, has been isolated from diseased areas on sugar beets. Inoculation experiments have verified its pathogenicity. The appearance of the fungus in culture is described.

The type specimen of Cylindrocladium scoparium Morg. (1892) was found on an old pod of Gleditsia triacanthos L. Since then it has been reported as a pathogen of various plants under humid conditions. It has been found to cause disease of roses (Massey, 1917), strawberries (Sherbakoff, 1933), evening primroses (Roldan, 1936), apricots, yerbamate (Ilex paraguayensis),



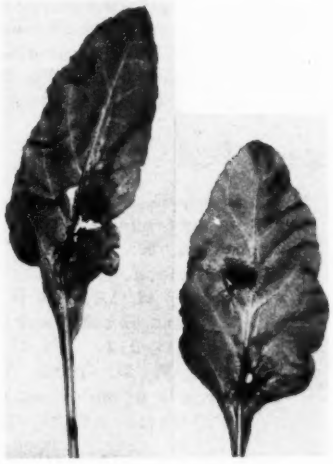


FIGURE 1. Sugar beet from Arlington Farm, Virginia, collected in 1938, showing symptoms of infection by Cylindrocladium scoparium.

FIGURE 2. Sugar beet leaves artificially inoculated with Cylindrocladium scoparium.

and Eucalyptus (Jauch, 1943), plum and cherry rootstocks (Wormald, 1944), figs (Mehta and Bose, 1947), ivy (Arnaud, 1949), and roots of tea bushes (Loos, 1951). Boedijn and Reitsma (1950) have published a comprehensive morphological and taxonomic review of the genus Cylindrocladium in which they list C. scoparium as occurring on sesbania seedlings, but they do not mention pathogenicity.

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[1] The work here reported is from a cooperative study made in 1948-49 by the Division of Sugar Plant Investigations and the Division of Mycology and Disease Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering. The inoculation studies were made by the late John E. Kotila, but the more comprehensive study that was planned was given up because of his death in 1951.

[2] Associate Mycologist, National Fungus Collection, Beltsville, Maryland.

In October, 1947, a diseased sugar beet root was collected at Blissfield, Michigan. It had a type of surface injury for which the term "scurf" seemed appropriate. Similar injury to sugar beets had been noticed at Arlington Farm, Virginia, at least as early as 1935. The injury was especially prominent at the root crown and at the base of the petioles (Fig. 1). The surface of the affected root was brown and cracked, forming scurfy necrotic areas; while the petioles were darkened and withered. A conidium-producing fungus isolated from the diseased area was determined to be C. scoparium. A series of inoculation tests were made to verify the pathogenicity of this fungus on sugar beets. These tests were conducted with precautions to prevent accidental infection of the plants and with adequate controls to assure validity of results.

Preliminary inoculation experiments resulted in infection of the test sugar beet roots, with disease apparent in the epidermal layer. More extensive experiments involving inoculation of roots of sugar beet plants without injury to the plants resulted in a considerable number of infections, with production of characteristic small sclerotia in the diseased areas of the roots. Inoculation of crowns and leaves of sugar beet plants resulted in lesions of the leaves (Fig. 2) and of some petioles, with appearance of small sclerotia in the diseased areas. Repetition of these tests confirmed the results, and diseased specimens were dried for preservation.

Culture study of C. scoparium from sugar beets gave the following results: On Difco Bacto corn meal agar a very scanty, loose white mycelial growth was soon visible, but after about a week the most prominent elements were numerous rust-colored sclerotial bodies 40-275 x 25-40 μ embedded in the agar and tending to form concentric zonate rings because of differences in abundance of sclerotia. No conidia were produced. On 2% Fleischmann's diamalt agar there was a moderately profuse mycelial growth overlying a very heavy concentration of sclerotia. Distribution of both hyphae and sclerotia was fairly uniform, but mycelial growth was heavier on the portion of agar bearing fewer sclerotia, and vice versa. No conidia were produced.

The culture characteristics seem to agree with those of C. scoparium isolated by Wormald (1944) from plum and cherry shoot wilt. Identification of the fungus from diseased sugar beets, culture studies, and inoculation experiments confirm that C. scoparium is a weak pathogen on sugar beets.

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PUFFBALL DAMAGED TOMATO SEEDLINGS

P. A. Young

Several square feet of tomato seedlings growing in rotting cow manure in a hotbed in July 1954 showed symptoms of damping-off, stunting, and browning of the leaves. The apparent cause was a thick layer of firm fungus mycelium packed with hard light yellow-tan spheres each 1/3 to 1/2 inch in diameter, under the tomato roots. The fungus remained hypogeous 1/2 to 1 inch below the surface of the soil during at least 2 weeks, acting like Disciseda.

By August, the fungus developed stipes 1 to 1 3/4 inches long that raised the puffballs above the surface of the soil, but they remained firm during about 4 weeks. The puffballs matured and dispersed their spores in September and October (Fig. 1), with air temperatures of 75 to 120° F in the hotbed. Thus it was more durable than common puffballs and seemed to be a hot-weather fungus as it was found only in summer. This fungus was identified as Tylostoma berteroanum Lév., by Dr. Jorge Wright in Argentina, who stated that this is the first record of this fungus in North America although it is common in Argentina.

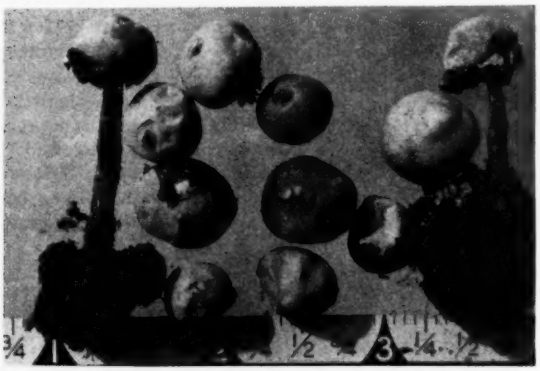

FIGURE 1. Tylostoma berteroanum that developed from a thick layer of mycelium below the roots of tomato seedlings in a hot bed. x about 15/16.

This fungus displayed an unusual form of pathogenesis on tomatoes. A pathogen preferably is defined as an organism that causes disease in another species of organism (1). The Tylostoma possibly was a mild facultative parasite, but acted mainly as a competitor like a phanerogamic weed in that it deprived the tomato roots of adequate minerals. Thus, it differed from classes of parasites previously described (2). T. berteroanum was questionably parasitic according to the preferred definition: A parasite is an organism that lives in or attached to another species of living organism from which it secures its food, water, or minerals.

Summary: Tylostoma berteroanum was the apparent cause of dwarfing and browning of tomato seedlings. They damped-off only where this fungus occurred. The thick layer of mycelium below the tomato roots probably deprived them of adequate minerals and possibly parasitized them.

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TWIG BLIGHT AND CANKER OF RED MULBERRY

E. Richard Toole[1]

During the summer of 1953 considerable twig blight was noticed on red mulberry (Morus rubra L.) in the Mississippi Delta. Trees 6 to 20 feet high were found affected. Dead and dying twigs up to 1/4-inch in diameter were observed in all parts of the crowns of affected trees. These diseased twigs were often conspicuous during the period that the dead and wilting leaves remained attached to them. Small cankers were found on some twigs. Isolations along the margin between the dead and healthy portions of these twigs consistently yielded Fusarium lateritium (Nees) Snyder & Hansen.

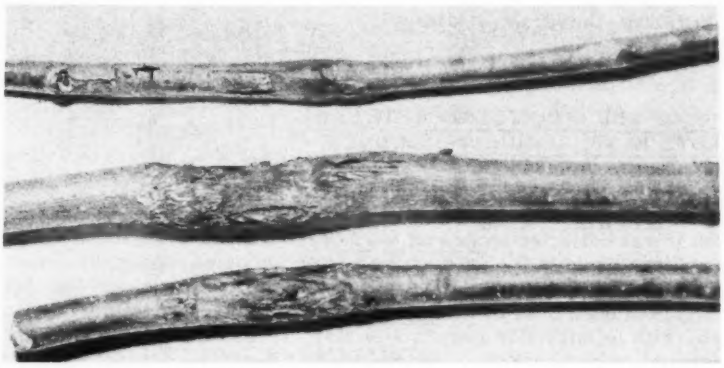

FIGURE 1. Cankers produced on red mulberry twigs after inoculation with Fusarium lateritium.

To determine whether F. lateritium caused the blight, 20 healthy mulberry twigs were inoculated with this fungus in September 1953. Inoculation was accomplished by placing bits of the fungus growing on agar into small incisions made through the bark into the stem wood. The wounds were covered with moist cotton held in place with drafting tape. Ten check twigs were treated similarly except that sterile agar was used in place of the fungus.

By May 1954, all inoculated twigs were diseased and half of them were dead. A year later, mortality had increased to 70 percent and all surviving twigs had cankers around the point of inoculation (Fig. 1). F. lateritium was reisolated from the inoculated twigs. The check wounds all healed over by May 1954.

The writer does not know of any previous report of F. lateritium causing twig blight of Morus rubra, though the fungus is widespread on M. alba[2]. Since the mulberry fungus has not been tested on other hosts, and since F. lateritium isolates from other hosts have not been tested on mulberry, it is too early to distinguish the mulberry isolates by a formal designation.

The distribution of the blight, as well as the means by which it spreads, remains to be discovered. So far, it has not been observed to kill trees.

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[1] Stationed at the Delta Research Center, Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. The Delta Research Center is maintained in cooperation with the Mississippi Agricultural Experiment Station at Stoneville, Mississippi. It is partially financed by the Southern Hardwood Forest Research Group.

[2] Weiss, F., and O'Brien, M. J. Index of plant diseases in the United States. U. S. Dept. Agr. Plant Disease Survey Spec. Pub. No. 1, pt 4. June 1952.

UNUSUAL RECORDS OF PLANT DISEASES

FUSICLADIUM ON PYRACANTHA

By D. F. Millikan[1] and T. W. Bretz[2]

On June 6, 1955, two diseased Pyracantha (firethorn) were sent in for examination. Lesions similar to those incited by the apple scab organism, Venturia inaequalis, were numerous on the leaves and microscopic examination revealed the characteristic olivaceous, pyriform conidia. The organism was tentatively designated Fusicladium pyracanthae (Otth.) Rostr. Sample diseased leaves were sent to Mr. John Stevenson of the National Fungus Collection, Horticultural Crops Research Branch, Beltsville, Maryland, who confirmed our identification. To our knowledge this is the first report of this fungus in Missouri.

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[2] Professor of Forestry, University of Missouri.

PROOF OF THE CONNECTION BETWEEN BUCKEYE RUST, AECIDIUM AESCULI, AND PUCCINIA ANDROPOGONIS

By John W. Baxter

Buckeye rust, Aecidium aesculi Ell. & Kell., was known only from Kansas and Nebraska until 1952, when it was collected on Aesculus glabra Willd. near Shenandoah, Iowa, by O. F. Hobart. Observations made in the area by the writer indicated a possible connection between the Aecidium on Aesculus and Puccinia andropogonis Schw. on big bluestem, Andropogon gerardi Vitman. Overwintered telia of P. andropogonis were used in May, 1954, to inoculate Aesculus glabra, with inconclusive results. In May, 1955, the reciprocal inoculation was made, using aecial material from Nebraska. Aeciospores of Aecidium aesculi were used to inoculate young plants of Andropogon gerardi grown from seed in the greenhouse. Uredia of P. andropogonis appeared on all the inoculated plants from seven to ten days after inoculation. Uninoculated check plants remained free of rust.

The writer wishes to thank Dr. W. W. Ray, Department of Botany, University of Nebraska, for providing the aecial material used in the inoculations.

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ADDITIONAL WOODY HOSTS OF ARMILLARIA MELLEA IN CALIFORNIA

By Robert D. Raabe

During the past two years, investigations involving the oak root fungus, Armillaria mellea (Fr.) Quél., have revealed several additional hosts of this fungus in California. Except where noted, all plants reported are thought to be new hosts of the fungus and in all plants, the fungus was present while the host was still living.

Plants in which natural infection occurred and the areas where found are: sweet gum, Liquidambar styraciflua L., Palo Alto, an undetermined variety of Hinoki cypress, Chamaecyparis obtusa Sieb & Zucc., Berkeley, creeping juniper, Juniperus horizontalis Moench, Berkeley, and American elm, Ulmus americana L., Oakland. A. mellea has previously been reported on the American elm in Missouri[1] and has been listed on unnamed species of Ulmus from France[2] and Holland[3].

In addition, ornamental plants set out by Dr. Harold E. Thomas beginning in 1938 in an area at the San Jose Deciduous Fruit Station known to be infested with the fungus and to which additional inoculum was added were pulled in the spring of 1955. The following plants were found to be infected: California box elder, Acer negundo var. californica Sarg.; strawberry-tree, Arbutus unedo L.; Catalina or feltleaf ceanothus, Ceanothus arboreus Green; Deutzia scabra Thunb.; maul or cañon oak, Quercus chrysolepis Liebm.; scrub oak, Quercus dumosa Nutt.; common or English cherry laurel, Prunus laurocerasus L.; and Laurestinus, Viburnum tinus L.

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[1] Bretz, T. W. 1944. Phloem necrosis of elms in Missouri. Plant Dis. Reptr. 28: 929-931.

[2] Guyot, R. 1927. Mycelium lumineux de l'Armillaire. Comptes rendus Soc. de Biol. 46: 114-116. (Abs. in Review of Applied Mycology 6: 586).

[3] Westerdijk, Johanna, Marie Ledeboer, and Johanna Went. 1931. Mededeelingen omtrent gevoeligheidsproeven van Iepen voor Graphiun ulmi Schwartz, gedurende 1929 en 1930. Tjdschr. over Plantenziekten 37: 105-110. (Abs. in Review of Applied Mycology 10: 695-696).

STEMPHYLIUM LEAF SPOT OF BIRDSFOOT TREFOIL IN IOWA

By John W. Baxter

Stemphylium leaf spot, caused by Stemphylium loti Graham, was found in plantings of birdsfoot trefoil near Ames and Colo, Iowa, during June and July, 1955. The disease appeared as reddish-brown, circular spots on the leaflets and coppercolored cankers on the stems. A species of Stemphylium answering the description of Stemphylium loti was isolated from lesions on leaves and stems. Stemphylium leaf spot of birdsfoot trefoil was first reported from the Northeastern United States by Graham in 1951[1]. It has not been previously reported from Iowa.

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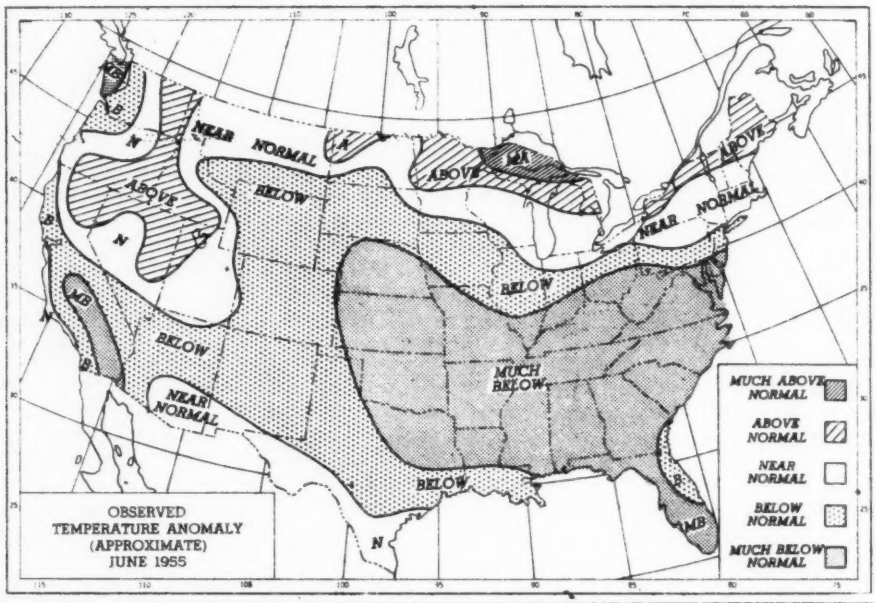
[1] Graham, J. H. 1951. Stemphylium leafspot and stem canker of birdsfoot trefoil. Plant Dis. Reptr. 35: 489.

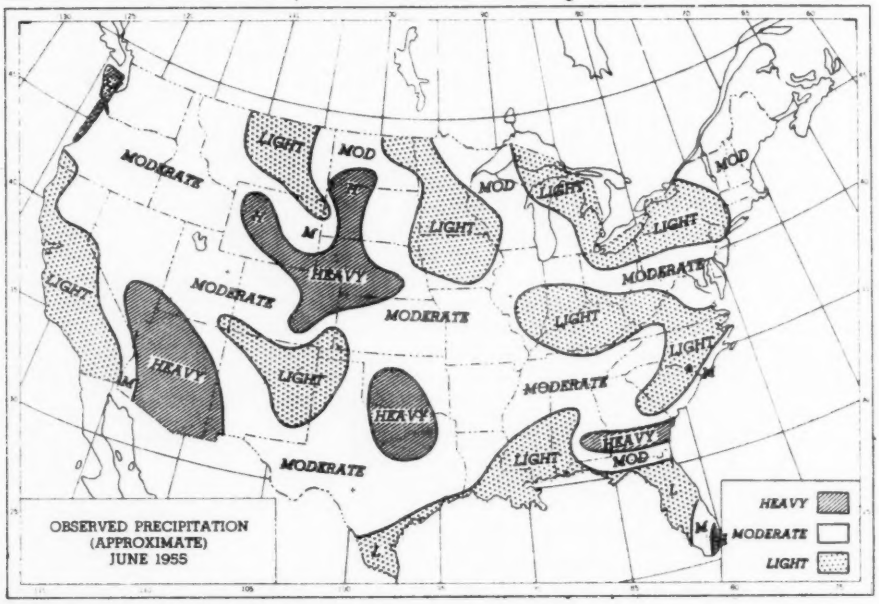
MARKET DISEASES ON THE NEW YORK CITY MARKET DURING JUNE 1955

By B. A. Friedman

Twenty percent of a car of western-grown Honeydew melons were reported damaged by a brownish skin discoloration and occasional sunken bleached areas. The trouble was suggestive of fungicide injury. A local retail florist has reported a loss of about $1,000 during the past 7 months caused by a spotting and vein discoloration of cut orchid flowers. The damage has occurred since a new refrigerated showcase has been installed whereas flowers remain normal in an old showcase. Tests are under way to ascertain the cause of the trouble. Ten percent of a carload of topped, Texas-grown beets were damaged by feeding injuries caused by insects. A Pittsburgh inspector sent in a sample of California-grown potatoes which averaged 1 percent damage by the tuber necrosis virus. An importer reported 50 percent of the large-sized fruit in a shipment of 19,000 crates of pineapples from Cuba were decayed. Blue mold rot (Penicillium) and Fusarium rot were the decays found. These probably followed mechanical injuries to the fruit. The principal decays found by the author in several cars of Florida-grown watermelons were Mycosphaerella black rot and Rhizopus rot. These followed skin injuries.

QUALITY MAINTENANCE AND IMPROVEMENT SECTION, AGRICULTURAL MARKETING SERVICE, U. S. DEPARTMENT OF AGRICULTURE, BELTSVILLE, MARYLAND





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

MANUSCRIPTS FOR THE PLANT DISEASE REPORTER

(See also PDR 35: 121-122; 36: 214, 494)

(1) GENERAL: The Reporter page measures 9 inches long with the heading or 8 3/4 inches for the text part, by 6 inches wide. The copy is typed on a larger page, 11 1/4 inches of text or 12 inches overall in length by 8 inches in width, and reduced 25 percent in the photographic process of reproduction. Illustrations or tables larger in either dimension will take a correspondingly greater reduction. Only one size of type is available for text, footnotes, or tables.

(2) MANUSCRIPTS should be the original ribbon copy, not carbons, clearly typed and double-spaced throughout, including tables, footnotes, and bibliographies. (Note -- only one copy is needed.) Footnotes should be typed at the bottom of the page.

(3) ABSTRACTS are requested for all except very short articles. (PDR 38: 316).

(4) CAUSES OF DISEASES should be named. For bacteria, fungi, nematodes, etc., give the Latin name of the organism; for viruses either or both the accepted common name of the virus or a Latin name if you prefer it and there is one; for non-parasitic diseases state the causal factor if it is known. If the cause of a disease has not been determined say so. (PDR 36: 494).

(5) LITERATURE REFERENCES should be given in alphabetical order and numbered for citation in the text. We follow the AIBS suggestion of placing the year of publication after the author's name. Please check your titles carefully since we cannot do it for you. Be sure that text citations and bibliography agree; that foreign-language references are correct; that number or month is cited for periodicals that are not paged consecutively throughout the volume.

(6) NAMES OF FUNGICIDES should be given according to the suggestions that will be published in Phytopathology before long, and later repeated in the Reporter. In the meantime see PDR 35: 122.

(7) ILLUSTRATIONS should be sent to us unmounted. To prevent mistakes, write figure numbers on the back, and mark the top of each print when necessary. A sketch can show a preferred arrangement but please keep in mind page size, shape, and standard reduction (see above under General), and remember that figure titles and legends are part of the page. Lettering should be clear and large enough to be legible after reducing. Drawings, maps, and graphs can be photographs or originals, but should be finished and ready for reproduction, not just sketches.

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(9) REPRINTS cannot be supplied since there is no way in which we can be reimbursed. However,

(10) The MULTILITH PLATES from which reprints can be made will be sent if requested at the time the article is submitted. The press size of these plates used for the Reporter is designated as small -- maximum image 9 1/2 by 13 inches, maximum paper size 9 3/4 by 14 inches -- for Model 1250. Most of the Experiment Stations have this type of multilith machine.

(11) We are the official correspondents in the United States of the PLANT PROTECTION BULLETIN published monthly by the United Nations Food and Agriculture Organization. We would appreciate it if plant pathologists would send us suitable material from time to time for inclusion in our monthly summary reports. Please mark it clearly so that we will know it is intended for the Bulletin. (See PDR 36: 492; 37: 637) -- P. R. M.